FlightSafety international

VOLUME 1
LEARJET 20 SERIES PILOT TRAINING MANUAL

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NOTICE

The material contained in this training manual is based on information obtained from the aircraft manufacturer's Pilot Manuals and Maintenance Manuals. It is to be used for familiarization and training purposes only.

At the time of printing it contained then-current information. In the event of conflict between data provided herein and that in publications issued by the manufacturer or the FAA, that of the manufacturer or the FAA shall take precedence.

We at FlightSafety want you to have the best training possible. We welcome any suggestions you might have for improving this manual or any other aspect of our training program.

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MANEUVERS AND PROCEDURES

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MANEUVERS AND PROCEDURES

INTRODUCTION

The general pilot information in this chapter is intended to supplement and expand upon information in other sources. It is not intended to supercede any official publication. If there is any conflict between the information in this chapter and that in any official publication, the information in the official publication takes precedence.

GENERAL

General pilot information includes Standard Operating Procedures and the maneuvers normally encountered during Learjet training and operations. The following abbreviations are used in this chapter.

ABBREVIATIONS

AFM	Airplane Flight Manual
AGL	Above Ground Level
ATA	Airport Traffic Area (Class D Airspace effective 9/16/93)
ATC	Air Traffic Control
CDI	Course Deviation Indicator
COM/NAV	Communication/Navigation
DH	Decision Height
FAF	Final Approach Fix
FL	Flight Level
HAA	Height Above Airport
HAT	Height Above Touchdown
M_{MO}	Mach, Maximum Operational
MSL	Mean Sea Level
N_1	Fan Speed
PF	Pilot Flying
PIC	Pilot in Command
PNF	Pilot Not Flying
SOP	Standard Operating Procedure
VDP	Visual Descent Point
V_{LE}	Velocity Flaps Extended
V_{MO}	Velocity Maximum Operational

IAF	Initial Approach Fix	**V_1**	Critical Engine Failure Speed
KIAS	Knots, Indicated Airspeed	**V_R**	Rotation Speed
MAP	Missed Approach Point	**V_{REF}**	Reference Speed
MDA	Minimum Descent Altitude	**V_2**	Takeoff Safety Speed
MEA	Minimum Enroute Altitude		

STANDARD OPERATING PROCEDURES

GENERAL

Standard Operating Procedures (SOPs) are used to supplement the information in the *AFM* and Federal Air Regulations. Adherence to SOPs enhances individual and crew situational awareness and performance. SOPs may include assignment of responsibilities, briefing guides and procedures to be followed during specific segments of flight. The SOPs in this section are not intended to be mandatory or to supersede any individual company SOPs. They are simply provided as examples of good operating practices.

RESPONSIBILITIES

PIC—The Pilot in Command is designated by the company for flights requiring more than one pilot. Responsible for conduct and safety of the flight. Designates pilot flying and pilot not flying duties.

PF—The Pilot Flying controls the airplane with respect to heading, altitude, and airspeed and accomplishes other tasks as directed by the PIC.

PNF—The Pilot Not Flying maintains ATC communications, obtains clearances, accomplishes checklists, makes altitude callouts and other tasks as directed by the PIC.

All crewmembers are responsible for providing advice and counsel to the PIC. The PIC may choose to accept or reject such advice. That is a prerogative of the PIC. But neither the PIC's acceptance nor rejection of advice relieves other crewmembers of the responsibility of providing it.

CHECKLIST PROCEDURES

Normally, the PF initiates all checklists. However, if the PNF thinks a checklist should be accomplished, and the PF has not called for it, the PNF should prompt the PF. For example, "Ready for the Approach checklist, Captain?"

FlightSafety International recommends the use of the checklist challenge and response concept. Using Normal Procedures checklists, the PNF challenges the PF and the PF responds. Using Abnormal or Emergency Procedures checklists, the PNF challenges the PF and, as a memory aid, also gives the checklist item response. The PF then responds.

The PF may elect to have the PNF accomplish some Abnormal or Emergency Procedure checklists on the PF's command. In this case, the PNF gives the checklist item and response. The PF replies with the response and the PNF accomplishes the action.

When a checklist has been completed, the PNF reports the checklist is complete and that he/she is standing by with the next checklist. For example, "Approach checklist complete. Standing by with the Before Landing checklist."

If an emergency occurs on takeoff after V_1 speed and takeoff is continued, no checklist should be initiated before the airplane reaches a safe altitude above the ground; at least 400 feet.

BRIEFING GUIDES

General

While the *Learjet AFM* does not specifically require before takeoff and approach briefings, such briefings are appropriate under some circumstances. The briefing guides presented below should be used when flying with unfamiliar crewmembers or any other time the PIC believes they are necessary.

It should be noted that many of these items can, and should, be briefed well before engine start. Many of them can be discussed before arriving at the airplane.

Pretakeoff Briefing

The pretakeoff briefing should address the following items:

- Type of takeoff; rolling or standing, flap setting, etc.
- Review takeoff data to include power setting and speeds
- Procedures to be used in the event of an emergency before or after V_1 speed including emergency return procedures
- Headings and altitudes to be flown during the departure including restrictions, if any
- Radio, navigational systems and flight director settings
- Anti-icing requirements, if applicable
- Specific PNF duties and callouts. (See "Takeoff Procedures," later in this section for additional information.)
- A request for "And questions?" directed to all cockpit crewmembers.

Approach Briefing

The approach briefing should be completed before starting descent and address the following items. The PF normally transfers airplane control to the PNF during the briefing.

- Approach to be used and backup approach, if available
- Special procedures to be used during the approach, such as circling approach procedures, interception of a radial from an arc, VDP, etc.
- Altitudes of IAF, FAF, stepdowns, sector and obstacles

- Minimums (DH, MDA), (HAT, HAA), radio altimeter setting
- Missed approach point and procedures, timing to MAP/VDP
- Radio (COM/NAV) setup desired
- Anti-icing requirements. Specific PNF duties and callouts. (See "Approach Procedures," later in this section, for additional information.)
- The procedure for transitioning to visual flight
- A request for "Any questions?" directed to all cockpit crewmembers

At the completion of the Approach briefing, the PF announces "Approach briefing complete," and reassumes control of the airplane if control has been transferred to the PNF.

TAKEOFF PROCEDURES

When cleared for takeoff, the PNF reports "Before Takeoff checklist complete, cleared for takeoff." The PF advances power toward the takeoff power setting, the PNF taps PF's hand and makes the final power setting.

At initial airspeed indication, the PNF cross-checks airspeed indicators and reports "Airspeed alive." PF releases nosewheel steering.

At V_1 speed, the PNF calls "Vee One." The PF releases the thrust levers and puts both hands on the control column.

At VR, the PNF calls "Rotate." The PF rotates airplane to a 9° noseup pitch attitude.

With positive rate of climb, the PF calls "Positive rate, gear up." The PNF positions the gear handle to up and calls "Gear selected up." The PNF monitors the gear while it is retracting and reports "Gear up," when retraction is complete.

Before V_{FE} (V_2 plus 30 knots minimum), the PF calls, "Flaps up, yaw damper on, and After Takeoff checklist." The PNF positions the flap handle to up and calls "Flaps selected up." The PNF monitors the flaps while they are retracting and reports "Flaps up," when retraction is complete. PNF accomplishes the After Takeoff checklist.

CLIMB AND CRUISE PROCEDURES

The PNF announces all assigned altitudes and sets them in the altitude alerter. The PNF also calls out 1,000 feet above, or below, all assigned altitudes and altitude restrictions. These calls normally are made by stating the existing altitude and the assigned altitude or restriction. For example, "Through 9,000 feet, cleared to 8,000," or "Through flight level 460 for 470." The PNF also announces other significant altitudes, such as, "Through 18,000 feet, altimeter 29.92," or, "Flight lever 410, going on oxygen."

The PF periodically announces his intentions and targets throughout the flight, such as "Accelerating to 250 knots," "Turning right to 260 degrees and descending to 3,000 feet," "We'll hold this heading until intercepting the 090 degree radial and then turn left to the station."

Any change in cockpit function is announced by the pilot making the change and acknowledged by the other pilot. For example, the PNF announces, "VOR number two set to Springfield and identified." PF acknowledges, "VOR two on Springfield." PF announces, "Autopilot engaged and coupled in climb and heading modes." PNF acknowledges, "Roger."

Transfer of airplane control is announced by the pilot initiating the change and acknowledged by the pilot assuming control. Specific target values are provided to the pilot assuming control. For example, the PF announces, "Take the airplane for a minute. We're climbing at 250 knots to 7,000 on a vector to the 045 radial." PNF acknowledges, "I've got the airplane, climbing at 250 to 7,000 on this heading until intercepting the 045 radial."

APPROACH PLANNING

Approach planning and briefing should be accomplished during cruise. Review hazardous terrain, MEAs, and minimum sector altitudes. Complete and review performance data to include V_{REF} speed, landing distance, approach climb speed, and power setting.

The PF directs the PNF to obtain destination weather or obtains it himself. If the PNF obtains the weather, the PF normally assumes ATC Communications while the PNF is obtaining weather. In either case, after checking weather, the pilot who did so briefs the other pilot on the destination weather, the expected approach, and any other significant information.

If a VDP has not been published, a "time to see the runway" may be computed as follows. Take the MDA, divided by 10, and subtract that, in seconds, from the time from the FAF to the MAP. For example, assume the MDA is 400 feet and the time from the FAF to the MAP is 1 minute and 45 seconds. Four hundred, divided by 10 equals 40. Subtracting that from 1:45 equals 1:05 from the FAF to see the runway. If the runway is not in sight at the end of that time, either a faster than normal rate of descent is required, or the airplane lands beyond the normal touchdown zone.

Normally, ATC determines when a descent may be started. However, descents may sometimes be started at the PF's discretion. To determine how far out to start descent for an approach, use 3 times the altitude to be lost, divided by 1,000. For example, to lose 40,000 feet, 3 times 40,000 equals 120,000, divided by 1,000 equals 120 miles out to start descent.

The Descent checklist should be started before, or early in, the descent to permit proper windshield heat and pressurization system operation.

Descent below flight level 180 will not be started before obtaining a local area altimeter setting.

DESCENT PROCEDURES

The same procedures used during climb and cruise are used during descent. The PNF accomplishes the Descent checklists, as directed by the PF, and makes altitude callouts to include the transition level and 10,000 feet.

APPROACH PROCEDURES

The PF initiates the Approach checklist when descending out of 18,000 feet or when within 50 miles of the destination airport. The checklist is accomplished so as to not interfere with the visual lookout for other traffic.

Configuration changes during the approach are accomplished using the same crew coordination techniques used after takeoff. The PF calls for a configuration change. The PNF acknowledges, selects the switch position, monitors and reports when gear and flaps are in the selected positions.

The Approach checklist is completed and the airplane slowed to V_{REF} + 40 knots (minimum) before reaching the IAF.

Over the IAF, for other than a straight-in approach, the PF terms outbound, calls for flaps 8°, slows the airplane to V_{REF} + 30 knots (minimum), and begins a descent, if necessary. The PNF starts timing, announces the time to be flown and the outbound course, or heading, and altitude, if an attitude change is required.

If a procedure turn is to be made, any accepted procedure turn maneuver may be used. At the expiration of the time from the IAF, the PNF announced that time is up, the direction of turn, and the next heading. For example, "Time's up, left turn now to 045 degrees." Wings-level outbound in the procedure turn, the PNF starts timing, announces the time to be flown and the next heading and altitude. At the expiration of the procedure turn outbound time, the PNF announces the time is up, the direction of turn, the next heading and altitude. For example, "Time's up, right turn now to 225° and cleared down to 3,000."

Approaching the final approach course, the PNF monitors the CDI or bearing pointer and reports "CDI alive," or "Within 5° of the inbound course."

> Established on final approach (within 2 1/2° for all approaches), the PF calls for flaps 20°, slows the airplane to V_{REF} + 20 knots (minimum), and begins a descent, if necessary. After the flaps have been set to 20°, the PF calls "Gear down, Before Landing checklist." The PNF extends the landing gear, completes the Before Landing checklist up to flaps down and reports, "Before Landing Checklist complete to full flaps."

Over the FAF, on a two-engine, straight-in approach, the PF calls for flaps 40°, slows the airplane to V_{REF} (minimum), and begins a descent. (For a single-engine, or circling approach, the flaps remain at 20° until the landing is assured.) The PNF begins timing, if necessary, extends the flaps and completes the Before Landing checklist. The PNF also confirms that the COM/NAV radios are set properly, checks the flight instruments, airspeed bugs, altitude alerter, radio altimeter setting and MDA or DH. The PNF then reports, "Before Landing checklist complete, no flags, cleared to descend to ________ feet."

After passing the FAF, the PNF begins looking for visual references outside the airplane. However, he/she also monitors the instruments and calls out significant deviations such as 1 dot, or more, deflection on the CDI or glide slope and airspeed variations greater than -0 to +10 knots from V_{REF}. If the PF does not respond to the callout, the PNF repeats it. If the PF does not respond to the second callout, the PNF assumes the PF has been incapacitated and announces that he/she (the PNF) is taking control of the airplane.

The PNF calls out the time to the VDP/MAP and 1,000, 500, and 100 feet above MDA or DH, and reaching MDA or DH. The PNF also reports visual contact with the ground such as, “Visual contact, no runway yet,” “Approach lights in sight at 11 o’clock,” or “Runway in sight straight ahead.” If a runway in sight has not been called by the PNF at MAP or DH, the PNF calls, “MAP or DH, no contact.”

Approaching minimums, or the missed approach point, the PF begins cross-checking outside the airplane for visual references. When satisfied that visual references are adequate for landing, the PF announces, “I’m going visual,” or “Going outside.” At this point, the PNF directs his attention primarily inside the airplane, while cross-checking outside, and calls airspeed, descent rate, and altitude. The purpose is to provide the PF, verbally, the same information he/she would have if still on instruments.

Airspeed should be called as plus or minus V_{REF}, descent rate as up or down and altitude above the ground. For example, “Plus 5, down 500, 100 feet,” indicates the airspeed is V_{REF} plus 5 knots, the airplane is descending at 500 feet per minute and is 100 feet above the ground.

GO AROUND/BALKED LANDING

If a go around/balked landing is necessary, the PF calls “Going around”, set power to take-off thrust and simultaneously establish a 9° noseup pitch attitude. Selecting the flight director to Go-around mode will disengage the auto-pilot and set the pitch bars to 9 degrees. Spoilers will be checked retracted and flaps set to 20 degrees. The PNF will confirm spoilers and flaps set as will call out the direction of turn if one is required, along with the missed approach heading and altitude. The PNF notifies ATC of the missed approach.

MANEUVERS

GENERAL

This section contains a description of most of the maneuvers that are likely to be encountered during Learjet training and operational flying. While there is always more than one way to fly an airplane, these procedures have been developed over many years of Learjet operations. They have proven to be safe, efficient, and readily manageable. These procedures are consistent with the *AFM*. However, if a conflict should develop between these procedures and those in the *AFM*, the *AFM* procedures should be used.

PERFORMANCE STANDARDS

The performance standards in Table MAP-1 should be maintained during all Learjet flight operations.

MINIMUM MANEUVERING SPEEDS

Minimum maneuvering speeds are expressed in terms of V_{REF} speed which is 1.3 times the stalling speed in the landing configuration.

For maneuvering with up to 30° of bank, the following minimum speeds should be used:

Spoilers deployed .... V_{REF} +50 KNOTS

Flaps up .... V_{REF} +40 KNOTS

Flaps 8° .... V_{REF} +30 KNOTS

Flaps 20° .... V_{REF} +20 KNOTS

Flaps 40° .... V_{REF} +10 KNOTS

For maneuvering with up to 15° of bank, on final approach for landing, for example, the following minimum speeds should be used:

Spoilers deployed .... V_{REF} +40 KNOTS

Flaps up .... V_{REF} +30 KNOTS

Flaps 8° .... V_{REF} +20 KNOTS

Flaps 20° .... V_{REF} +10 KNOTS

Flaps 40° .... V_{REF}

Table MAP-1. PERFORMANCE STANDARDS

Steep Turns

Bank angle:	45°, ±5°
Altitude:	±100 feet
Airspeed:	±10 KIAS
Heading:	±10°

Approach to Stall

Initiate recovery at stick shaker onset
Recover with minimum altitude loss

Holding

Altitude:	±100 feet
Airspeed:	±10 knots

Instrument Approaches

Initial:	Altitude:	±100 feet
	Airspeed:	±10 knots
Final:	Airspeed:	-0, +5 knots
	Localizer:	± one dot
	Glide Slope:	±one dot
	Bearing Pointer:	±5°
MDA:	Altitude:	-0, +50 feet

Circling Approaches

Bank Angle:	30° maximum
Altitude:	-0, +100 feet
Airspeed:	-0, +5 knots

Missed Approach

DH:	Altitude:	-0 before initiation of the missed approach
MDA:	Altitude:	-0, unless runway environment had been in sight before the missed approach.

Landings

Traffic Pattern:	Airspeed:	±10 knots
	Altitude:	±100 feet

Final Approach:	Airspeed:	-0, +5 knots

POWER SETTINGS

Actual power settings vary depending upon the temperature, pressure altitude, and airplane gross weight. The following target settings are approximate, but may be used to provide a starting point to determine the actual power setting.

Below 10,000 MSL, 78% rpm1 to maintain 200 KIAS, 83% rpm to maintain 250 KIAS.

Between 10,000 MSL and FL 250, 84% rpm to maintain 250 KIAS.

TAKEOFF

Either 8 or 20° of flaps may be used for takeoff. The normal, standing takeoff (Figure MAP-1) must be used to achieve the performance specified in the *AFM*. If the runway available is at least 10 percent longer than the planned takeoff distance, a rolling takeoff may be used. The procedures are the same except for a standing takeoff, power is set before brake release. For a rolling takeoff, the brakes are released before the power is set. During a rolling takeoff, takeoff power must be set before the runway remaining equals the takeoff distance.

Normally, before V_{FE} (V_2 plus 30 knots minimum), the flaps are retracted and the After Takeoff checklist is accomplished. However, if traffic conditions warrant, the After Takeoff checklist may be delayed until the airplane is clear of local traffic.

Approaching 200 knots, the PF should adjust pitch and power if necessary, to maintain 200 knots or less within the ATA (Class D Airspace). For passenger comfort and ease of airplane control, it is recommended that the pitch attitude not exceed 20° noseup.

The maximum continuous climb power setting is 95% rpm below 10,000 feet and 98% above 10,000 feet.

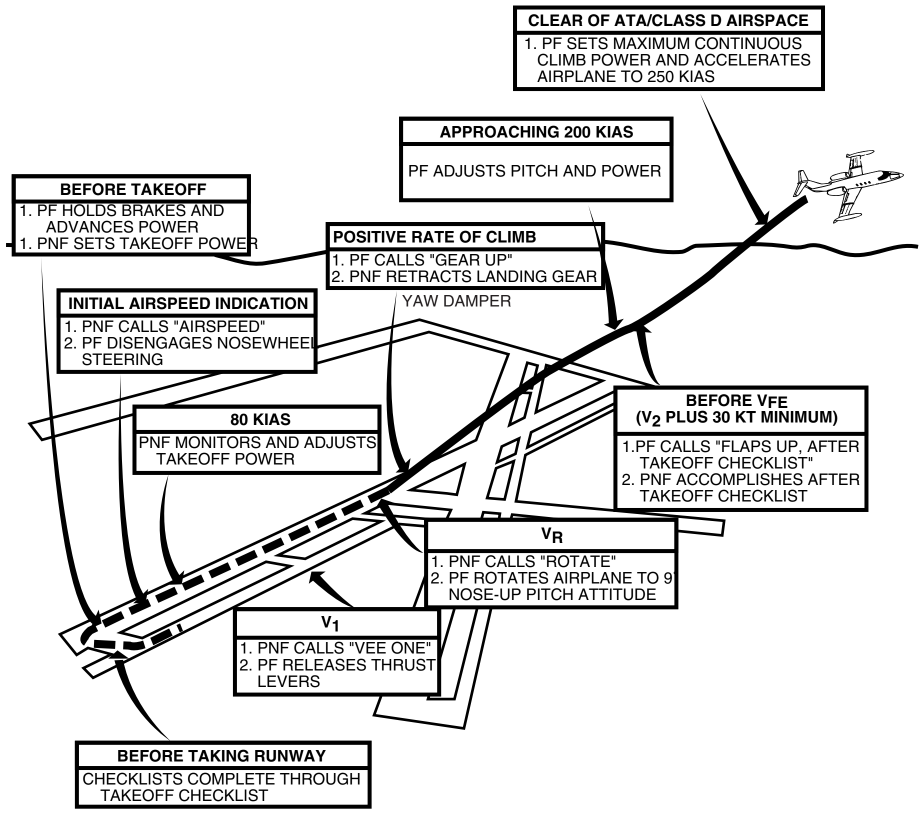


Figure MAP-1. Normal Takeoff

ENGINE FAILURE BELOW V_1 SPEED

If an engine fails below V_1 speed (Figure MAP-2), the takeoff must be aborted. The PF simultaneously reduces power to idle, applies maximum braking and deploys the spoilers. The drag chute or thrust reversers (if installed) are deployed if necessary.

Takeoffs may be aborted for malfunctions other than engine failure, however, the same procedures should normally be used.

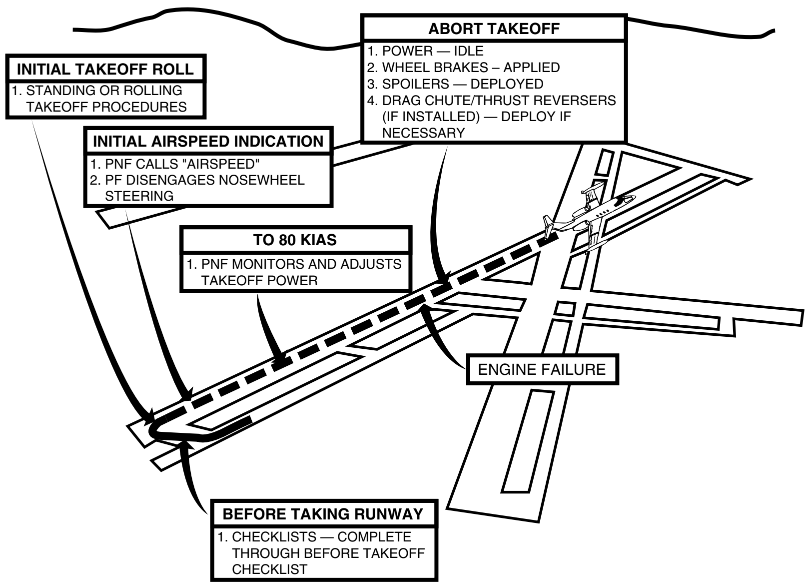


Figure MAP-2. Rejected Takeoff

ENGINE FAILURE ABOVE V_1 SPEED

If an engine fails above V_1 speed (Figure MAP-3), the takeoff is normally continued. The PF maintains directional control with ailerons and rudder and keeps the nosewheel on the runway until reaching rotate speed. After liftoff, the initial climb is made at V_2 speed with takeoff flaps until the airplane is clear of obstacles or, if there are no obstacles, to 1,500 feet AGL. The PF then accelerates the airplane to V_2 plus 30 knots (minimum) and directs the PNF to retract the flaps. The PF then accelerates the airplane to single-engine climb speed (normally 200 knots) and climbs to the assigned altitude.

At a safe altitude above the ground (normally, no lower than 400 feet), the memory items for the Engine Failure/Fire Shutdown in Flight checklists are completed. The rest of the Engine Failure/Fire Shutdown in Flight checklists, and the After Takeoff checklist, are normally completed at, or above, 1,500 feet AGL. The crew then elects to obtain clearance to return to the departure airport for landing or proceeds to an alternate airport.

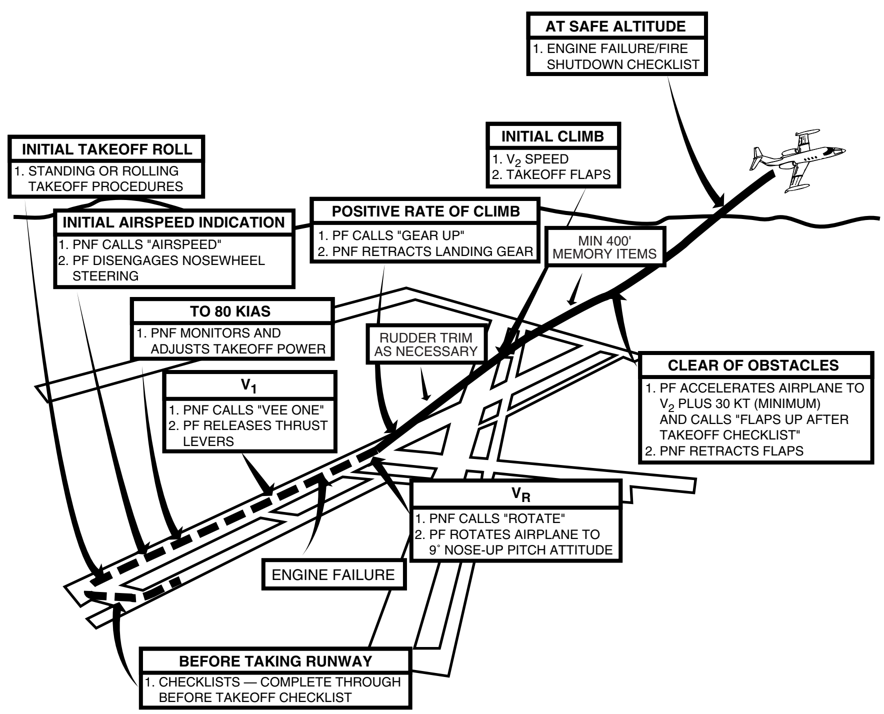


Figure MAP-3. Engine Failure At or Above V_1 Speed

STEEP TURNS

Steep turns (Figure MAP-4) are used to build confidence in the airplane and improve instrument cross-check. They may be accomplished at any altitude above 5,000 feet AGL. The higher the altitude, the more difficult the maneuver is to perform correctly. Steep turns are accomplished without flight director steering commands since the flight director does not command 45° of bank.

Power must be increased approximately 2% to maintain airspeed during steep turns. The airplane should be kept in trim and the bank angle should be held constant. If altitude corrections are necessary, they should be make in pitch only. It is not necessary to shallow the bank to climb during a steep turn in a Learjet.

Steep turns of at least 180°, preferable 360°, should be practiced in each direction.

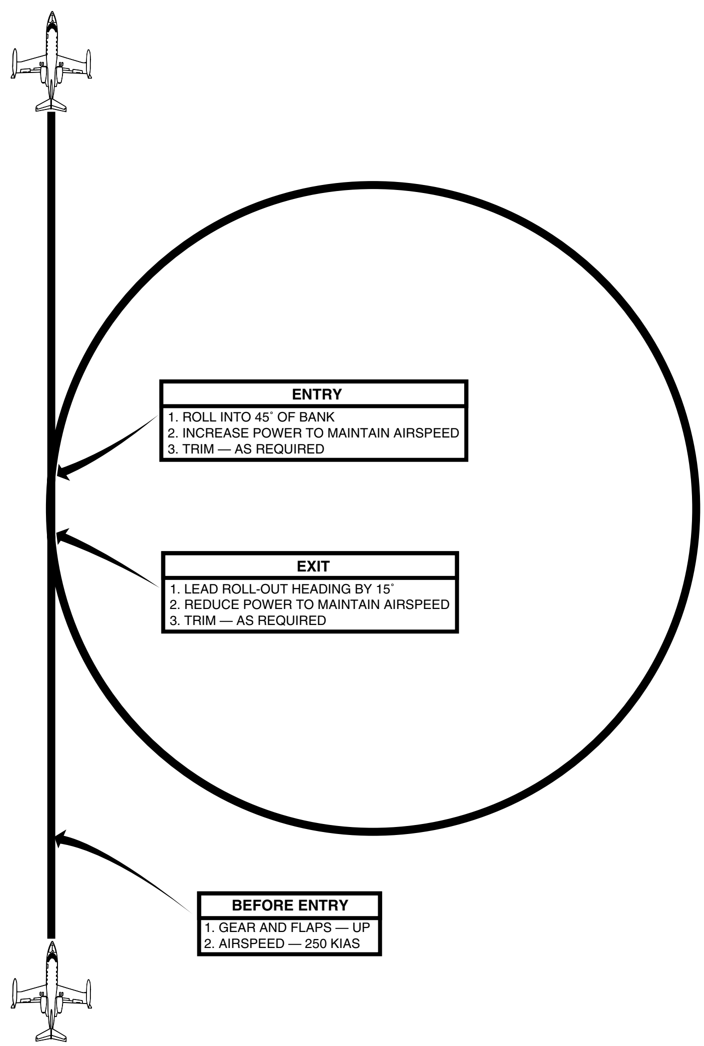


Figure MAP-4. Steep Turns

SLOW FLIGHT

Slow flight is used to develop the pilot's sense of feel for the airplane's low-speed handling characteristics and improve the pilot's coordination and instrument cross-check. Slow flight is accomplished in the clean, takeoff, and landing configurations (Figures MAP-5, MAP-6 and MAP-7), and is normally accomplished between 10,000 and 15,000 feet MSL. Slow flight should not be accomplished below 5,000 AGL.

Slow flight may be practiced while maintaining a constant altitude and heading or while maintaining a constant altitude and making turns to preselected headings. Slow flight may also be practiced while making constant rate climbs and descents to preselected altitude. Slow flight practice may be terminated by a recovery to normal cruise or an approach to stall.

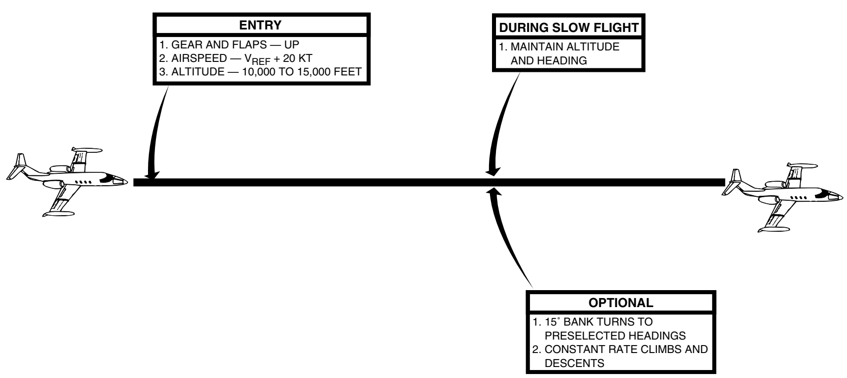


Figure MAP-5. Slow Flight—Clean Configuration

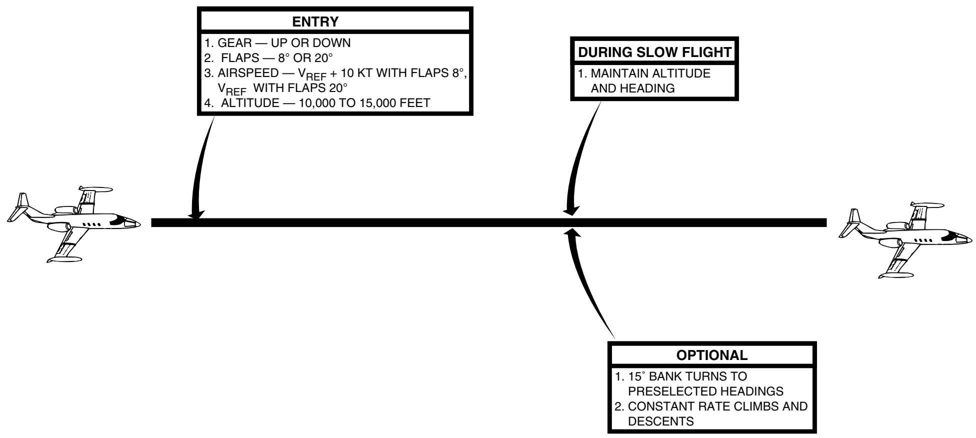


Figure MAP-6. Slow Flight—Takeoff Configuration

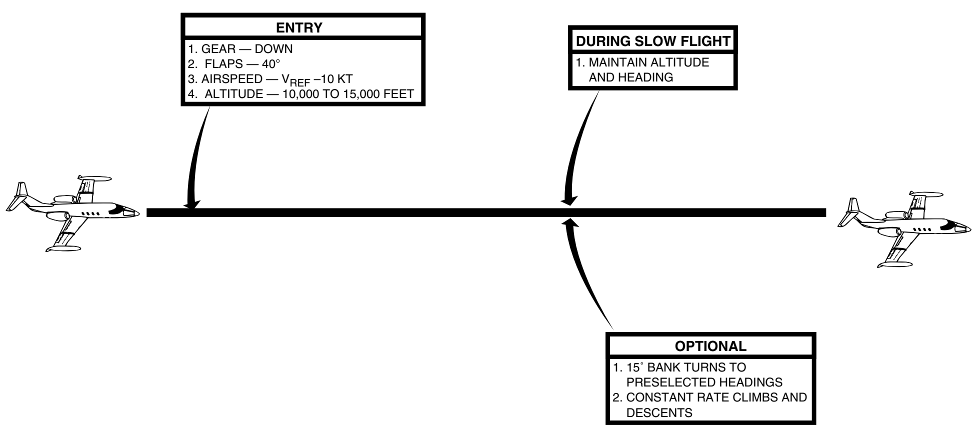


Figure MAP-7. Slow Flight—Landing Configuration

APPROACH TO STALL

Approaches to stalls are accomplished in the clean, takeoff, and landing configurations (Figures MAP-8, MAP-9, and MAP-10), and are normally accomplished between 10,000 and 15,000 feet MSL. Approaches to stalls should not be accomplished below 5,000 AGL. Approaches to stalls may be made from level or turning flight with 15 to 30° of bank. Approaches to stalls may also be combined with slow flight practice. All recoveries are made with power and minimum loss of altitude.

Approach to stall recovery is initiated at the first indication of an impending stall. This indication is provided by the stick shaker and stall warning annunciator lights which activate as the angle-of-attack indicator needle moves into the yellow band.

Power should be advanced to maximum and the existing pitch attitude maintained. To set maximum power in minimum time, the PF should move the thrust levers smoothly forward to the stop. However, the angle-of-attack indicator should be monitored and the pitch attitude reduced, if necessary, to keep the needle at the line between the green and yellow bands.

The PNF should monitor and adjust the power setting if necessary. Approaches to stall from the landing configuration are normally terminated by a simulated missed approach (Figure MAP-10).

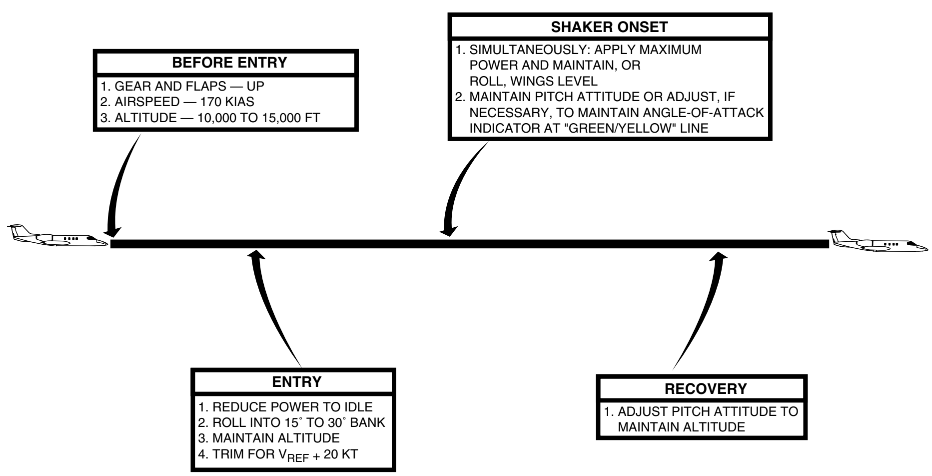


Figure MAP-8. Approach to Stall—Clean Configuration

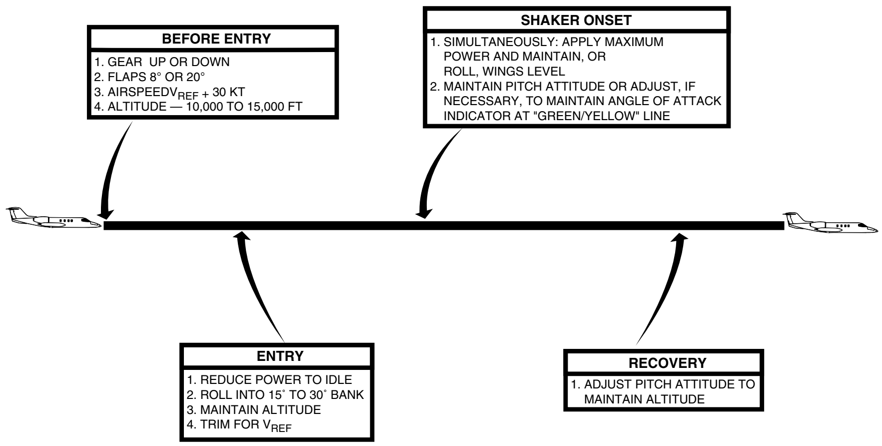


Figure MAP-9. Approach to Stall—Takeoff Configuration

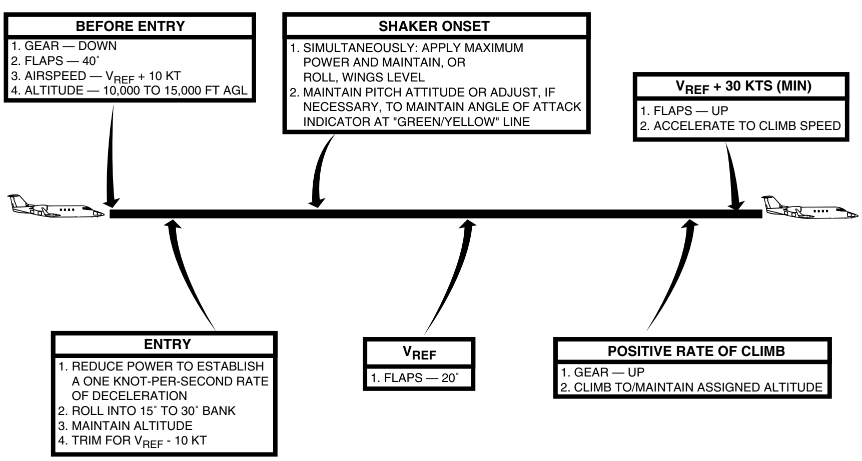


Figure MAP-10. Approach to Stall—Landing Configuration

EMERGENCY DESCENT

Emergency descents are accomplished in accordance with *AFM* procedures as shown in Figure MAP-11. The PF should accomplish the checklist memory items and allow the airplane to pitch down to a 10 to 15° nosedown pitch attitude. This pitch attitude is maintained until the airplane accelerates to M_{MO}/V_{LE}. Then the pitch attitude is adjusted to maintain M_{MO}/V_{LE}.

After the emergency descent has been established, the crew should determine the desired level-off altitude.

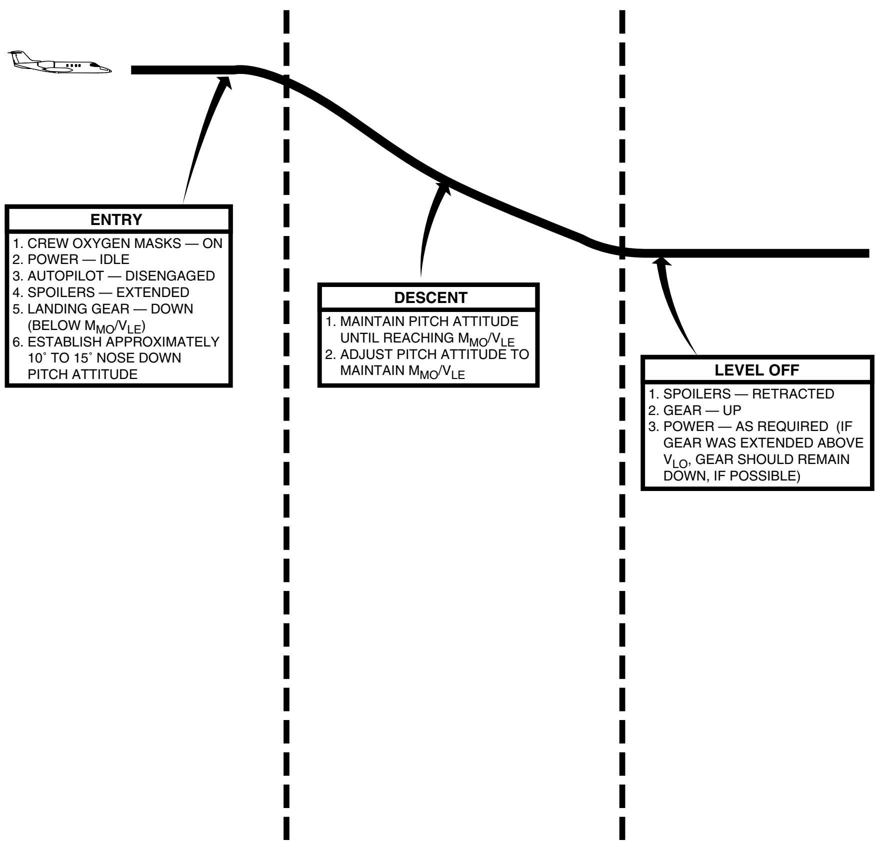


Figure MAP-11. Emergency Descent

VISUAL TRAFFIC PATTERN, TWO ENGINES

A two-engine visual traffic pattern is shown in Figure MAP-24. The airspeeds indicated on the diagram are minimums. Traffic pattern altitude for jet airplanes is normally 1,500 feet AGL. During gusty wind conditions, 1/2 the gust velocity should be added to V_{REF} on final approach. If a crosswind exists, final approach should be flown with a drift correction angle (crab) to maintain alignment with the runway centerline. Approaching touchdown, rudder should be applied to align the airplane with the runway centerline and the upwind wing lowered with aileron to prevent drift.

VISUAL TRAFFIC PATTERN, SINGLE ENGINE

A single-engine visual traffic pattern is flown exactly the same as a two-engine pattern except for the flap setting on final approach. For a single-engine landing, final approach is flown the flaps 20° at V_{REF} plus 10 knots minimum until the landing is assured. When the landing is assured, flaps should be extended to 40° and the airspeed slowed to V_{REF}. Additionally, the PF may elect to have the PNF remove 1/2 of the rudder trim on final approach, no lower than 500 feet above the airport.

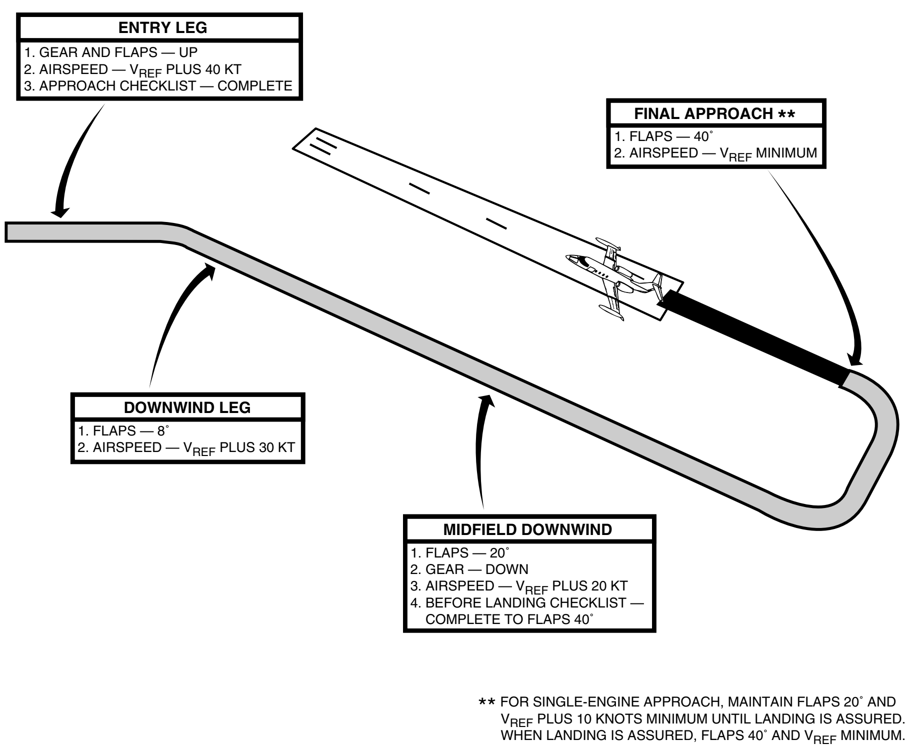


Figure MAP-12. Visual Traffic Pattern

FLAPS UP LANDING

The corrected landing distance for a flaps up landing (Figure MAP-13) is determined by multiplying the normal landing distance by 1.35. Considerations should be given to reducing the airplane's weight, if possible, to lower the landing speed and reduce landing distance, if the available runway length is marginal.

The yaw damper should be disengaged prior to landing on all models of 20's.

To avoid excessive floating during the landing flare, the PF should establish the landing attitude as power is reduced to idle, maintain the attitude and allow the airplane to touch down.The use of the drag chute, or thrust reversers, (if installed) is recommended during a flaps up landing.

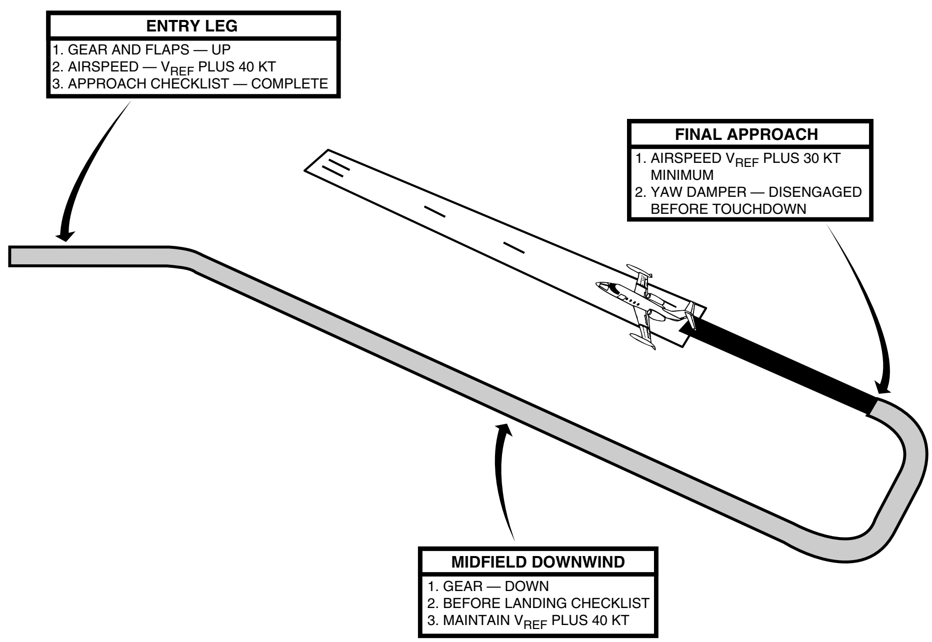


Figure MAP-13. Flaps Up Landing

PRECISION INSTRUMENT APPROACH

A typical, precision instrument approach is shown in Figure MAP-14. All accepted instrument flying procedures and techniques should be used while making instrument approaches in the Learjet.

Two-engine, precision approaches should be flown with a stabilized airspeed and configuration from the final approach fix (FAF) inbound. Single-engine, precision approaches should be flown with flaps 20° at V_{REF} plus 10 knots minimum from the FAF inbound until the landing is assured, then flaps 40° and V_{REF} minimum.

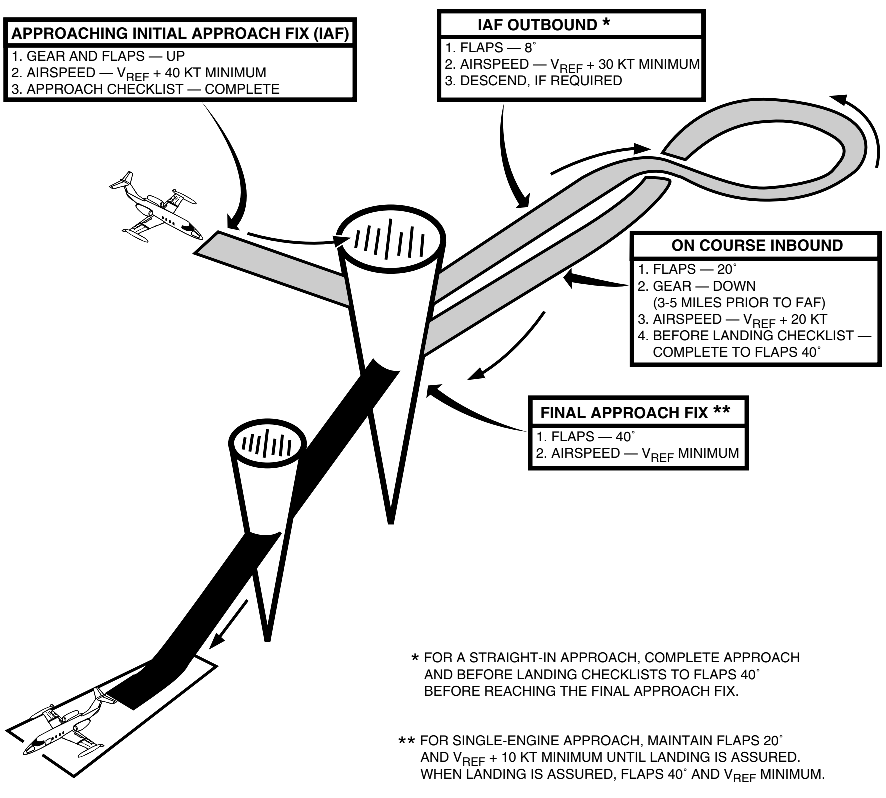


Figure MAP-14. Precision Instrument Approach

NONPRECISION INSTRUMENT APPROACH

A typical, nonprecision instrument approach is shown in Figure MAP-15. All accepted instrument flying procedures and techniques should be used while making instrument approaches in the Learjet.

Two-engine, nonprecision approaches should be flown with a stabilized airspeed and configuration from the final approach fix (FAF) inbound. Single-engine, nonprecision approaches should be flown with flaps 20° at V_{REF} plus 10 knots minimum from the FAF inbound until the landing is assured, then flaps 40° and V_{REF} minimum.

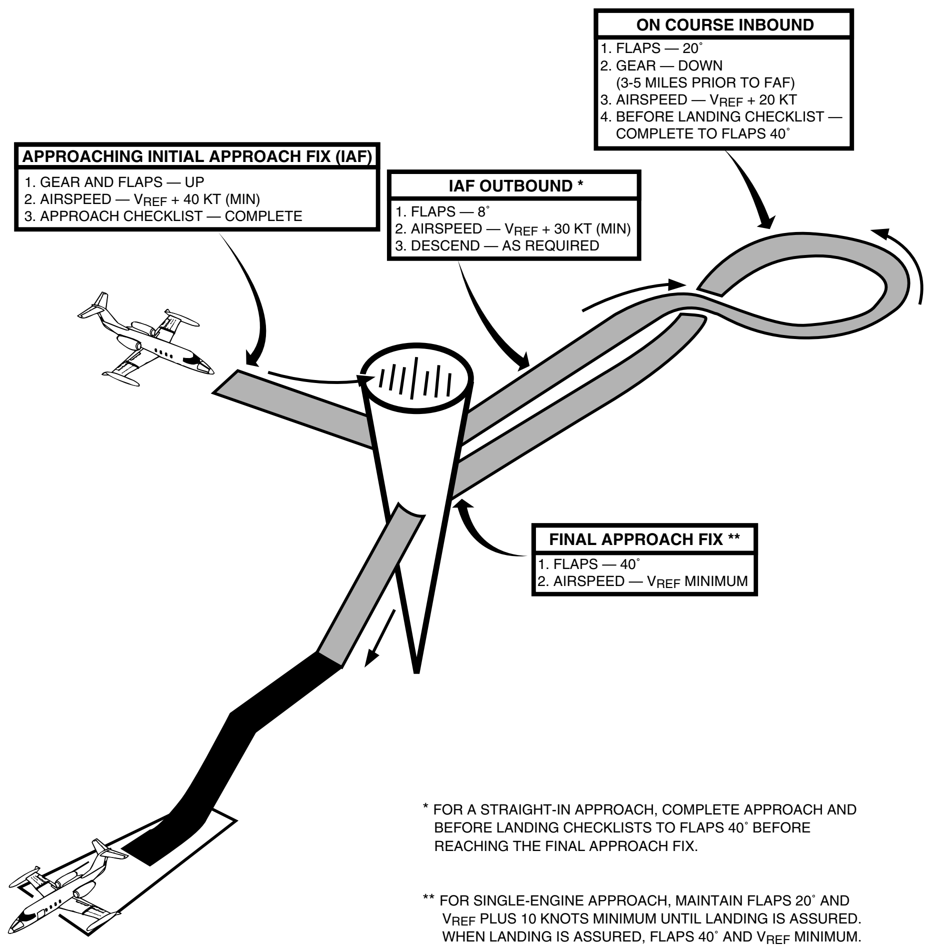


Figure MAP-15. Nonprecision Instrument Approach

CIRCLING INSTRUMENT APPROACH

Any instrument approach that requires a heading change of 30° or more to line up with the landing runway is a circling approach. An identifiable part of the airport must be distinctly visible to the pilot during the circling approach, unless the inability to see an identifiable part of the airport results only from a normal bank of the airplane. The circling MDA and weather minima to be used are those for the runway to which the approach is flown.

The Learjet is an approach category C airplane. However, category D minimums should be used if the airplane will be maneuvered at speeds over 141 knots (the minimum for category D airplanes) during the circling approach.

There are two types of circling approaches. The first type of circling approach positions the airplane within 90°, or less, of the runway heading on a base leg for landing. With two engines, this type of approach is normally flown with the gear down and 20° of flaps at V_{REF} plus 20 knots minimum from the FAF inbound. When landing is assured, extend flaps to 40°. Airspeed may be reduced to V_{REF} minimum.

The second type of circling approach (Figure MAP-16) requires a heading change of more than 90° to line up with the landing runway. With two engines, this type of approach is normally flown with the gear down and 20° of flaps at V_{REF} plus 20 knots minimum from the FAF inbound. On final approach, flaps should be extended to 40° and airspeed reduced to V_{REF} minimum.

All single-engine circling approaches should be flown with 20° of flaps at V_{REF} + 20 knots from the FAF inbound. When landing is assured, flaps should be extended to 40° and airspeed reduced to V_{REF} minimum.

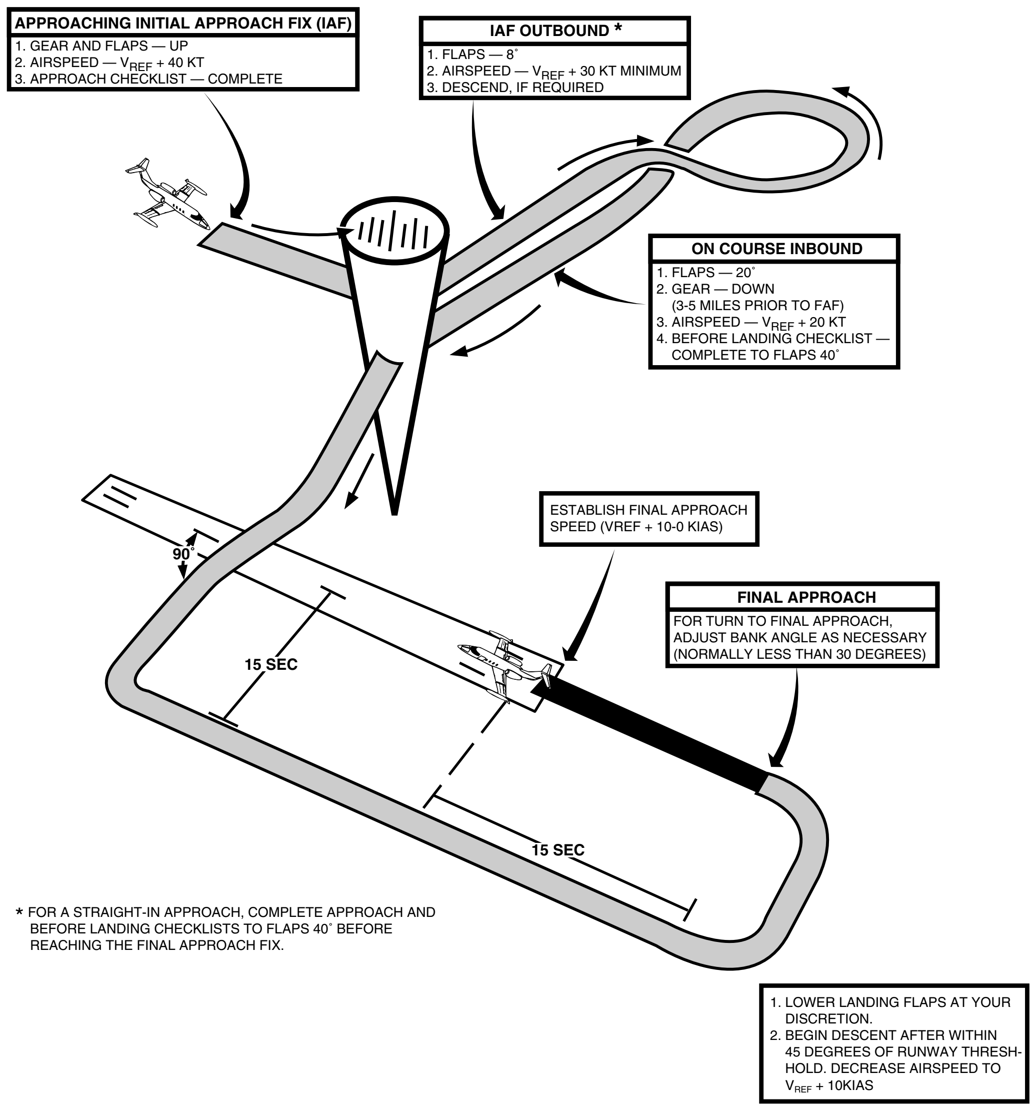


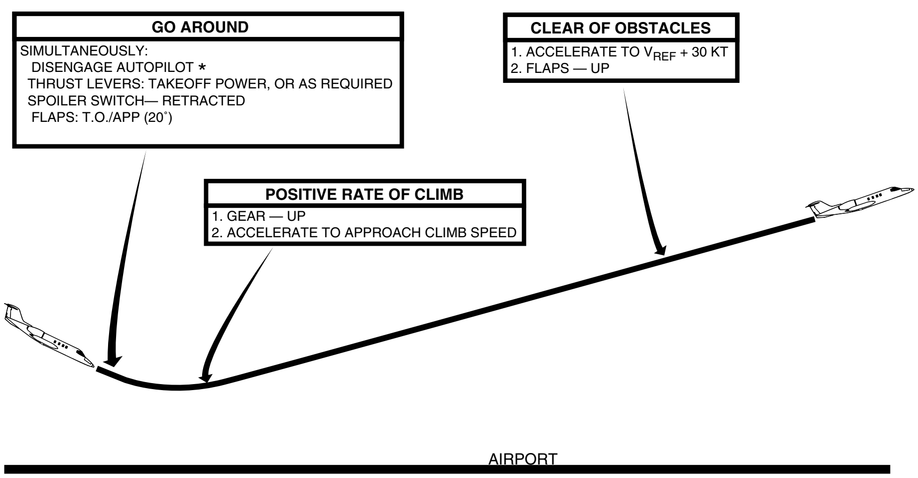
Figure MAP-16. Circling Instrument Approach

GO-AROUND/BALKED LANDING

The Learjet go-around/balked landing procedure, shown in Figure MAP-17, should be used for all missed approaches. Generally, if a missed approach is started at, or above, MDA or DH, it is considered a go-around. If a missed approach is started below MDA or DH, it is considered a rejected, or balked, landing. During training, rejected, or balked landings will normally be initiated over the runway threshold at an altitude of approximately 50 feet.

In either case, use of the flight director go-around mode is recommended to provide a target 9° nose-high pitch attitude. After the airplane is clear of obstacles and the flaps have been retracted, the pitch attitude and power may be adjusted to maintain the desired airspeed.

If the go-around/balked landing is made from an instrument approach, the published missed approach procedure should be accomplished unless otherwise instructed. If the go-around/balked landing is made during a circling approach, the initial turn to the missed approach heading must be made toward the landing runway. The turn may then be continued until the airplane is established on the missed approach heading.



* SELECTING FLIGHT DIRECTOR GO AROUND MODE WILL DISENGAGE THE AUTOPILOT AND PROVIDE A 9 DEGREE NOSE-UP PITCH COMMAND.

Figure MAP-17. Go-Around/Balked Landing

SINGLE-ENGINE DRIFT DOWN

The single-engine drift down procedure is used to cover the greatest possible distance while descending to single-engine cruise altitude after an engine failure at high altitude.

As the note on the chart explains, the speed schedule depicted also approximates the best single-engine, rate-of-climb speed below the single-engine service ceiling. This speed schedule may then also be used to climb to single-engine cruise altitude after an engine failure at low altitude.

PERFORMANCE

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PERFORMANCE

INTRODUCTION

Airplane performance is affected by many variables in addition to the usual ones, such as airplane weight, density altitude, runway length, etc. In the case of the Learjet 20 series, performance is also affected by type of engine, type of wing, design, and type of brakes installed.

GENERAL

Most performance data for all approved operating conditions is provided in chart form in the Performance section of the approved *Airplane Flight Manua*l. Except for Models 23 and 24, climb, cruise, and descent data are provided in the *Learjet Pilot's Manual*. Airplane performance data is also provided in tabular form in the *Pilot's Manual* and the aircrew checklist. However, the effects of wind, runway gradient, anti-skid-off, and anti-ice on conditions are not compensated for in the tabular data in the crew checklists or the *Pilot's Manual*. Therefore, if any of the above are factors, the *AFM* charts should be used for flight planning.

Weight and balance data is presented in the Weight and Balance section of the *AFM*.

Assumed Conditions

The performance data presented for each phase of operation is based on certain assumed conditions. Assumed conditions, along with the description of the corresponding charts, are given in this chapter.

Standard Conditions

Standard conditions which apply to all performance calculations are:

- Ambient temperature and pressure altitude
- Winds
- Gross weight
- Runway gradients
- Anti-ice on or off
- Anti-skid on or off
- Flaps 8°, 10°, 20°, or 10° overspeed for takeoff and 40° for landing

DEFINITIONS

The following contains the symbols and definitions which are used in the Performance section of the *AFM*.

Speeds

IAS	**Indicated Airspeed** Airspeed indicator reading (assumes zero instrument error)
V_{MCA}	**Minimum Control Speed, Air** The minimum flight speed at which the airplane is controllable with 5° of bank toward the good engine when one engine suddenly becomes inoperative and the remaining engine is operating at takeoff thrust.
V_{MCG}	**Minimum Control Speed, Ground** The minimum speed on the ground at which control can be maintained using aerodynamic controls alone, when one engine suddenly becomes inoperative and the remaining engine is operating at takeoff thrust.
V_1	**Critical Engine Failure Speed** The speed at which, due to engine failure or other causes, the pilot may elect to stop or continue the takeoff. If engine failure occurs at V_1, the distance to continue the takeoff to 35 feet will not exceed the usable takeoff distance. The distance to stop the airplane will not exceed the accelerate-stop distance. V_1 must not be less than V_{MCG} or greater than V_R.
V_R	**Rotation Speed** The speed at which rotation is initiated during takeoff to attain takeoff performance.
V_2	**Takeoff Safety Speed** The actual speed at 35 feet above the runway surface as demonstrated in flight during single-engine takeoff. V_2 is maintained to 1,500 feet above the runway or until clear of obstacle to produce the maximum climb gradient. V_2 must not be less than 1.2 times the stalling speed, less than 1.1 times V_{MCA}, or less than V_R plus an increment in speed attained prior to reaching 35 feet above the runway.
V_{SO}	The stalling speed in the landing configuration.
V_{S1}	The stalling speed in the appropriate gear/flap configuration.
V_{REF}	**Landing Approach Speed** The airspeed equal to 1.3 V_{SO} with the airplane in the landing configuration.

Distances

Accelerate-Stop Distance	The horizontal distance traversed from brake release to the point at which the airplane comes to a complete stop on a takeoff during which the pilot elects to stop at V_1. This distance is based on a smooth, dry, hard-surface runway.
Accelerate-Go Distance	The horizontal distance traversed from brake release to the point at which the airplane attains a height of 35 feet above the runway surface on a takeoff during which one engine fails at V_1 and the pilot elects to continue.
Takeoff Field Length	Distance presented in the takeoff distance charts and equal to the accelerate-stop distance or the accelerate-go distance, whichever is greater.

Meteorology

ISA	**International Standard Atmosphere**
RAT	**Ram-Air Temperature** The static air temperature corrected for full adiabatic compression rise corresponding to the calibrated Mach number and multiplied by a recovery factor
Wind	The wind velocities recorded as variables on the performance charts are the headwind or tailwind components of the actual wind at 20 feet above the runway surface.
Demonstrated Limited	Adequate control of the airplane during takeoff and landing was actually demonstrated. This value may or may not be limiting. See the appropriate *AFM*.

Miscellaneous

Static Position Correction	The static position correction is applied to indicated airspeed or altitude to eliminate the effect of static pressure source location on the instrument reading. Instrument error is assumed to be zero.
Takeoff Brake Energy Limit	Expressed in the Takeoff Weight limits charts as the maximum gross weight at which an aborted takeoff can be initiated at V_1 and completed within the computed accelerate-stop distance, using maximum braking effort.
Landing Brake Energy Limit	Expressed in the Landing Weight Limit charts as the maximum gross weight at which the airplane can be brought to a full stop within the computed landing distance, using maximum braking effort.

Runway Gradient — Change in runway elevation per 100 feet of runway length. The values given are positive for uphill and negative for downhill gradients.

Gradient of Climb — The ratio of the change in height during a portion of the climb to the horizontal distance traversed in the same interval.

Gross Climb Gradient — The climb gradient that the airplane can actually achieve given ideal conditions.

Net Climb Gradient — The gross climb gradient reduced by 0.8% during the takeoff phase. This conservatism is required by FAR 25 for terrain clearance deter mination to account for variables encountered in service.

Climb Segments (In Order of Occurrence)

First Segment Climb — The first segment climb begins from the point at which the airplane becomes airborne and ends at the point at which the landing gear is fully retracted. Refer to Table PER-1 for the applicable configura tion. Gross climb gradient with one engine inoperative and the other engine at takeoff thrust must be positive, without ground effect. This requirement is satisfied by compliance with the applicable Takeoff Weight Limits Chart.

Second Segment Climb — The second segment begins at the end of gear retraction and contin ues to height above the runway of 1,500 feet and V_2 speed. It is noted that the second segment in Figure PER-1 is shown only to a height of 400 feet. However, this is a minimum requirement and for simplified flight planning, the Takeoff Flight Path charts shown in the Flight Manual present the second segment required gradients to the 1,500-foot point for obstacle clearance considerations.

Table PER-1. CLIMB CONFIGURATIONS

TYPE OF CLIMB	NO. OF ENGINES OPERATING	THRUST	FLAP SETTING	GEAR POSITION
First Segment	1	Takeoff	Takeoff	Down
Second Segment	1	Takeoff	Takeoff	Up
Final Segment	1	Max cont	Up	Up
Enroute	1	Max cont	Up	Up
Approach	1	Takeoff	20°	Up
Landing	2	Takeoff	Dn-40°	Down

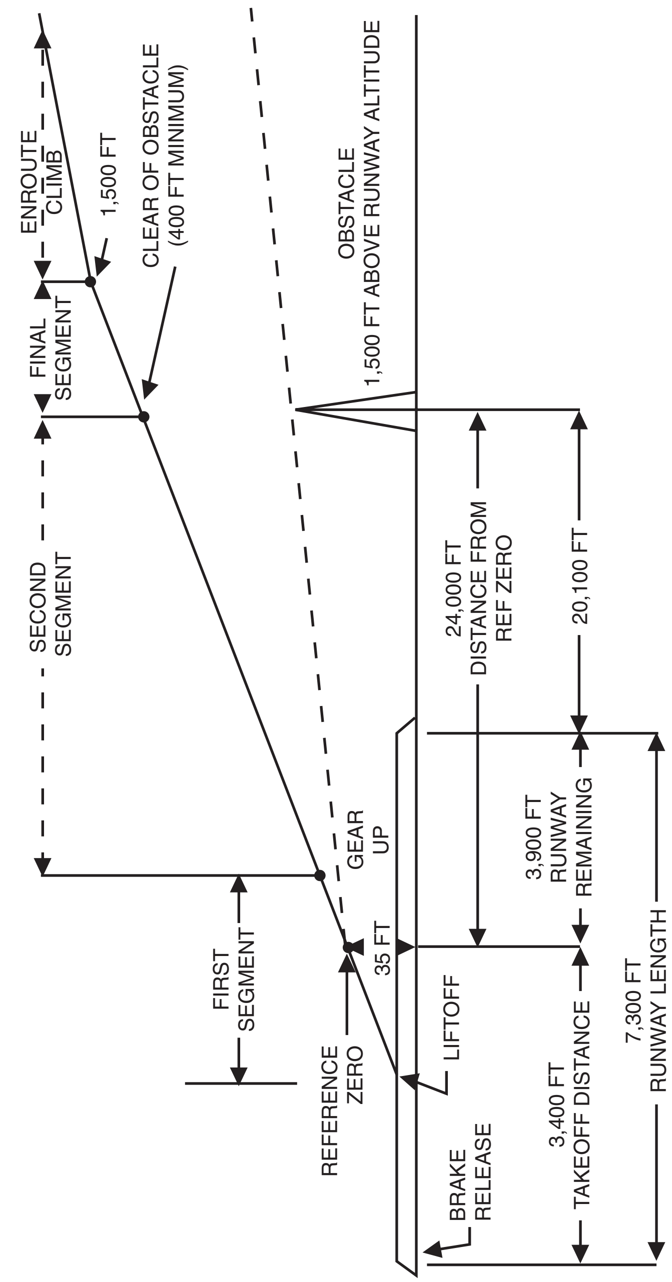

Figure PER-1. Takeoff Profile

Final Segment Climb

Final segment climb begins t the end of the second segment and ends at a height of at least 1,500 feet AGL. The gross climb grad ient must be at least 1.2% with one engine not operating and the other engine at maximum continuous thrust. This requirement is satisfied by compliance with the applicable Takeoff Weight Limits chart. Airspeed for this segment is 1.25 V_S. The final segment climb gradients are presented for pilot's reference and are not used in the takeoff path calculation.

Enroute Climb

Enroute climb is a climb with flaps up, landing gear retracted, and maximum continuous thrust on one engine. There is no minimum re quirement for enroute climb gradients. The enroute net climb gradients are presented for pilot's reference. Velocity is presented in the Enroute Climb Speed Schedule chart.

Approach Climb

This climb is made from a missed or aborted approach. With the air plane in the appropriate configuration (flaps 20°, gear up, and takeoff thrust on one engine), the gross climb gradient must be at least 2.1%. This requirement is satisfied by compliance with the Landing Weight Limits chart. Airspeed for this maneuver is 1.3 V_{S1}.

Landing Climb

This climb is made from an aborted landing. When the airplane is in the landing climb configuration (flaps and gear down, takeoff thrust on both engines), the gross climb gradient must be at least 3.2%. This requirement is satisfied by compliance with the Landing Weight Limits chart. Landing climb airspeed is 1.3 V_{S0}.

TAKEOFF PERFORMANCE

Wind Components

Headwind, tailwind, and crosswind components can be calculated by using the Wind Component chart found in the General section of the *AFM*, "Performance Data" chapter. This value is entered on the Takeoff Worksheet (Figure PER-2).

Maximum Allowable Takeoff Weight

The maximum allowable takeoff weight at the start of takeoff roll is limited by the most restrictive of the following requirements:

- Maximum certificated takeoff weight
- Maximum takeoff weight to meet minimum single-engine climb gradient requirements and not exceed brake energy limits (climb or brake energy limited)
- Maximum takeoff weight for runway length available
- Maximum takeoff weight for obstacle clearance
- Maximum landing weight for destination airport

TAKEOFF WORKSHEET

TEMP ____________ RWY LENGTH ____________ WEATHER ____________

PA ____________ RWY GRAD ____________ ANTI-ICE ____________

WIND ____________ ANTI-SKID ____________

TAKEOFF WEIGHT LIMITS (POUNDS)

	CERTIFICATED TAKEOFF WT	CLIMB WT	BRAKE ENERGY WT	TAKEOFF WT FOR RWY LENGTH	PLANNED TAKEOFF WT	TAKEOFF DISTANCE
FLAPS						
FLAPS						

OBSTACLE CLEARANCE

OBSTACLE HEIGHT ____________ OBSTACLE DISTANCE FROM END OF RUNWAY ____________

	GROSS WT (from above or estimate)	TO DIST	DIST FROM REF ZERO*	CLIMB GRAD REQUIRED	CLIMB GRAD POSSIBLE
FLAPS					
FLAPS					

FLAPS					
FLAPS					

FLAPS					
FLAPS					

*Distance from Reference Zero = Obstacle distance from end of runway + runway length - takeoff distance

EPR	V_1	V_R	V_2

Figure PER-2. Sample Takeoff Worksheet

Maximum Certificated Takeoff Weight

Maximum certificated takeoff weights vary according to model—refer to the appropriate *AFM* for the airplane weight.

Maximum Takeoff Weight (Climb or Brake Energy Limited)

The Takeoff Weight Limit charts found in the Takeoff section of the *AFM*, "Performance Data" chapter, provide the maximum takeoff weight for a given temperature and pressure altitude (PA). This will allow the airplane to meet minimum climb gradients if an engine fails at or after V_1 speed and takeoff is continued or braking to a full stop without exceeding brake energy limits if takeoff is rejected at or below V_1 speed. There are separate charts for takeoff with flaps at 8°, 10°, 20°, and 10° overspeed depending on type of wing and for Century III wings with and without Softflite (AMK 83-5 or AAK 79-10).

Maximum Takeoff Weight for Runway Available

If the computed takeoff field length determined from the *AFM* Takeoff Distance chart is less than the runway length available, takeoff weight is not limited due to runway length. However, if the computed takeoff distance exceeds the runway length available, the airplane gross weight must be reduced or takeoff delayed until atmospheric conditions change (cooler temperature, increased wind velocity, or wind shift to a longer runway, etc.).

The maximum takeoff weight, limited by available runway, can be determined by entering the Takeoff Distance chart on the right side with the runway length available and working backward to the Gross Weight section. Read the gross weight directly below the point at which these two entries intersect in the Gross Weight section. This is the gross weight that will permit takeoff within the runway length available.

Maximum Takeoff Weight for Obstacle Clearance

Takeoff flight path charts are provided in the Takeoff section of the *AFM*, "Performance Data" chapter, to enable the operator to determine the net climb gradient required to clear an obstacle in the takeoff flight path. Additionally, climb gradient charts are provided in the same section which enables the operator to determine the net climb gradient possible (one engine inoperative) for airplane gross weight and existing atmospheric conditions.

In the event that the computed climb gradient required exceeds the single-engine climb gradient possible, the airplane takeoff gross weight must be reduced or takeoff delayed until atmospheric conditions change to allow the computed climb gradient possible to exceed the climb gradient required.

Reducing the airplane's gross weight increases climb gradient possible. At the same time, climb gradient required also decreases because the takeoff distance is reduced, providing more distance from the obstacle. Therefore, an interpolative process is required to find the exact minimum gradient and maximum weight for obstacle clearance. This process will be described further in the example.

Takeoff Flight Path

Takeoff flight path charts are provided for 8°, 10°, and 20° flap settings.

Both close-in and distant charts are provided to determine the climb gradient requirements for obstacle clearance from Reference Zero.

The origin for each climb gradient line is Reference Zero (Figure PER-1). This is a point 35 feet above the runway at the computed takeoff distance. The climb gradient lines are divided into first and second segments. For purposes of flight path calculations, the second segment extends to 1,500 feet AGl, and the final segment flight path is not considered. Dee Howard Mark II and XR performance charts do not show first segment climb performance.

Horizontal distance from Reference Zero is calculated by adding the runway remaining beyond Reference Zero to the distance between the end of the runway and the obstacle.

In addition to finding the climb gradient required, note whether the obstacle falls within the first or second segment. If the intersect point is to the left of the Gear Down—Gear Up line, the obstacle is in the first segment. If the intersect point is to the right of the line, the obstacle is in the second segment. It is important to note this in order to select the proper climb gradient chart (first segment or second segment) to find the climb gradient possible for this example. Note also that the climb gradient lines on the chart have a different value in the first and second segments.

Climb Gradients

First, Second, and Final Segment Climb Gradient charts are provided to determine the climb-gradient possible for airplane gross weight and atmospheric conditions. First and Second Climb Gradient charts (Flaps 8°, 10°, or 20°) are used in conjunction with the Takeoff Flight Path charts, which show required net gradients for obstacle clearance. The Final Segment Climb Gradient chart is provided for reference only.

As previously mentioned reducing takeoff gross weight reduces climb gradient required and increases climb gradient possible.

As a result, finding the maximum takeoff gross weight that allows obstacle clearance becomes an interpolative process. A suggested method for accomplishing this is to average the climb gradient possible and climb gradient required and enter the Climb Gradient chart on the right with this value.

Takeoff Speeds (V_1, V_R and V_2)

These speeds are found in the Critical Engine Failure Speed (V_1), Rotation Speed (V_R), and Takeoff Safety Speed (V_2) charts in the AFM. Separate charts are provided for 8°, 10°, 20°, and 10° overspeed flap settings. For a review of theses abbreviations (V_1, V_R, and V_2), see Definitions in this chapter.

Critical Engine Failure Speed (V_1)

Data provided by the Critical Engine Failure Speed chart is based on three assumptions: takeoff power is set before brake release, the takeoff runway is dry, hard, and smooth, and tires and brakes are operating at normal efficiency.

These assumptions are of particular importance anytime the computed takeoff distance approaches the available runway length. When these assumed conditions are not met, there is no assurance of being able to stop the airplane within the computed takeoff distance if takeoff is rejected at V1 speed.

Rotation Speed (V_R)

Rotation speed is affected only by airplane gross weight.

Takeoff Safety Speed (V_2)

Takeoff safety speed (V_2), like rotation speed, is affected only by airplane gross weight.

Takeoff Field Length

Takeoff field length data assumes a smooth, dry hard-surface runway.

The takeoff distances computed from the takeoff distance charts in the AFM are accurate only when the following procedures are used:

1. Set takeoff EPR prior to brake release.
2. Rotate to approximately 9° noseup at V_R.
3. For engine failure after V_1, accelerate to V_2 after liftoff and then adjust pitch, as required, to maintain V_2.

The pilot must use these procedures whenever the computed takeoff distance is at or near the actual runway length. Otherwise, the actual takeoff distance may exceed the chart value and runway length available. Takeoff power settings are discussed later under Takeoff Thrust in this chapter.

The Takeoff field length data presented in the *AFM* is governed by the accelerate-stop or the engine-out accelerate-go distance, whichever is greater.

The Takeoff Distance charts in the *AFM* are presented for 8°, 10°, 20°, or 10° overspeed flaps settings. These charts may be used to determine either of the following:

1. Runway length required for a given airplane weight.
2. Maximum airplane takeoff weight corresponding to a specific runway length. The process for finding the maximum airplane weight for a given runway length was previously described in this chapter under Maximum Takeoff Weight for Runway Available.

THRUST

Takeoff Thrust

Takeoff performance is based on the assumption that the engines will be operating at a specific engine pressure ratio for a given temperature and pressure altitude (takeoff power). Takeoff power must be maintained from brake release to 35 feet above the runway or until obstacle clearance in the event of engine failure on takeoff.

Takeoff from a standing start with takeoff thrust set before brake release must be accomplished when the computed takeoff distance is at or near actual runway length. Also takeoff from a standing start must be accomplished to ensure computed obstacle clearance performance.

The more comfortable rolling takeoff may be accomplished when actual runway length is at least 10% longer than computed takeoff distance, and obstacle clearance is not a factor. When takeoff roll is initiated before setting takeoff power, ensure that takeoff thrust is established before reaching the point at which the runway remaining equals the computed takeoff distance.

If EPR is below that specified in the Takeoff Power Setting charts for the existing temperature and pressure altitude, airplane takeoff performance will not meet the takeoff performance specified in the performance charts. If EPR is above computed takeoff power, airframe or engine limits may be exceeded. Thus, it is necessary to compute takeoff power and adjust the power levers as necessary to set EPR equal to chart value. In addition, operation at a specific EPR should always be within EGT and rpm limits.

NOTE

During takeoff, EPR will decay approximately 0.015 from the initial static setting.

Maximum Climb Thrust

The climb performance data is predicated on adjusting thrust EPR after takeoff to the value found in the Maximum Continuous Thrust (EPR) tables in the *AFM*.

The maximum continuous thrust (EPR) setting may be determined before takeoff using estimated temperature and altitude at start of climb. Since the Maximum Continuous Thrust (EPR) table is based on ram-air temperature in degrees Celsius, the reported or estimated OAT must be converted to RAT before entering the chart.

CLIMB, CRUISE, AND DESCENT PLANNING

For those airplanes which have a *Pilot's Manual*, an Operational Planning Form is provided in the Flight Planning Data section of that manual. See Figure PER-3 in this chapter for a sample form.

Gates Learjet

Pilot's Manual I

OPERATIONAL PLANNING FORM

	WEIGHT	TIME	DISTANCE	FUEL
ZERO FUEL WEIGHT				
FUEL LOAD				
RAMP WEIGHT				
WARMUP & TAKEOFF				
Altitude =				
START CLIMB WEIGHT				
CLIMB				
END CLIMB WEIGHT				
Altitude =				
START CRUISE WEIGHT				
CRUISE				
END CRUISE WEIGHT				
Altitude =				
START CLIMB WEIGHT				
CLIMB				
END CLIMB WEIGHT				
Altitude =				
START CRUISE WEIGHT				
CRUISE				
END CRUISE WEIGHT				
Altitude =				
START CLIMB WEIGHT				
CLIMB				
END CLIMB WEIGHT				
Altitude =				
START CRUISE WEIGHT				
CRUISE				
END CRUISE WEIGHT				
Altitude =				
START DESCENT WEIGHT				
DESCENT				
END DESCENT WEIGHT				
Altitude =				
RESERVES				
ZERO FUEL WEIGHT				
	TOTALS			

NOTES:

Figure PER-3. Sample Operational Planning Form

Climb Performance

A set of climb performance tables is provided in the *Pilot's Manual* to determine time, distance (no wind), and fuel required for climb from sea level. If climb is initiated at an altitude above sea level, subtraction of performance values for the cruise altitude results in the time, distance, and fuel required for climb between two altitudes.

Each chart provides the climb performance data for a specific airplane gross weight at the start of the climb.

Cruise Performance

Cruise performance tables are provided in the airplane checklist or the *Pilot's Manual* for normal cruise, high-speed cruise, and long-range cruise.

Normal Cruise

Normal cruise tables provide fuel flows and true airspeed for constant 0.77 Mach cruise. Engine power is adjusted to maintain the constant Mach as weight decreases. Enter the appropriate table for the average airplane gross weight for each cruise segment.

High-Speed Cruise

High-speed cruise tables provide fuel flows, indicated Mach or airspeed, and the true airspeed for an M_{MO}/V_{MO} or V_{MAX} at maximum continuous thrust. Enter the appropriate table for the average airplane gross weight during each cruise segment.

Long-Range Cruise

In planning long-range cruise, the selected cruise altitude should provide the maximum air nautical miles per pound of fuel for a given airplane weight.

It can be seen from the chart that as airplane gross weight decreases, the altitude that provides best fuel economy increases. Therefore, when planning for maximum range, the cruise portion of the flight should be divided into segments, with an appropriately higher cruise altitude planned as airplane gross weight decreases. As a rough guide in planning for changes in cruise altitude, increase cruise altitude 1,000 feet for each 1,000-pound decrease in gross weight (fuel used).

Descent Performance

Descent Performance Schedules are provided in the *Pilot's Manual* to provide time, distance (no wind), and fuel used for descent to sea level. Subtraction of performance values for two altitudes results in time, distance, and fuel required for descent between the two altitudes. The descent speed schedules presented at the bottom of the table should be followed to achieve the desired results.

Fuel Reserve

FAR Part 91 requires a fuel reserve (IFR conditions) of 45 minutes at destination or at the alternate airport if an alternate is required. Fuel reserve is computed at normal cruise speed. The airplane checklist or *Pilot's Manual* also contains a Holding Operations table which provides maximum endurance holding speed and fuel flow for the airplane weight and pressure altitude.

APPROACH AND LANDING PERFORMANCE

Approach and performance data are provided in chart form in the *AFM* Performance section and in tabular form in the *Learjet Pilot's Manual and Checklist*. A sample Landing Worksheet is shown in Figure PER-4.

LANDING WORKSHEET

TEMP ____________ RWY LENGTH ____________ WEATHER ____________

PA ____________ RWY GRAD ____________ ANTI-ICE ____________

WIND ____________ ANTI-SKID ____________

CERTIFI-CATED LANDING WT	APPR CLIMB WT	BRAKE ENERGY WT	LANDING WT FOR RWY LENGTH	PLANNED LANDING WT	LANDING DISTANCE

V_{REF}	APPR CLIMB SPEED

Figure PER-4. Sample Landing Worksheet

Maximum Allowable Landing Weight

The maximum allowable landing weight is limited by the most restrictive of the following requirements:

- Maximum certificated landing weight
- Maximum landing weight (approach climb or brake energy limited)
- Maximum landing weight for the runway length available

Maximum Landing Weight (Approach Climb or Brake Energy Limited)

The Landing Weight Limit charts (Approach Climb and Brake Energy Limited) provide a maximum approach/landing weight which allows the airplane to meet a minimum climb gradient (single engine) in the event of missed approach or braking to a full stop without exceeding brake energy limits.

Maximum Landing Weight for Runway Available

If landing distance for existing gross weight is computed to be greater than the runway available, the gross weight must be reduced before using that runway. Landing weight for runway length available may be determined by working through the Landing Distance chart backward. Use the same procedure as previously described for finding maximum takeoff gross weight for a given runway length.

This computation is made using the same method as that used to fund maximum takeoff weight for runway available. Enter the Landing Distance chart on the right and work backward in the chart to the Gross Weight section and draw a light line through the Gross Weight section.

Now enter the chart on the left with temperature and pressure altitude and proceed to the Gross Weight section. The maximum landing weight for runway available is read directly below the point at which the two entries intersect in the Gross Weight section.

Landing Distance

The landing distances computed from the Landing Distance chart can be achieved when the following procedures are used:

1. Approach through the 50-foot point over the end of the runway at V_{REF} with flaps and gear down, using a 2 1/2-3° glide slope.
2. After passing through the 50-foot point, progressively reduce thrust until thrust levers are at IDLE prior to touchdown.
3. After touchdown, extend spoilers immediately.
4. Apply wheel brakes as soon as practical and continue maximum braking action until the airplane stops.
5. After landing, move the control column full aft and maintain that position until the airplane stops.

Pulling the control column aft will shift weight to the main wheels and improve braking efficiency. Pull the control column as far aft as possible but do not lift the nosewheel.

The Landing Distance chart is based upon smooth, dry, hard-surface runways. The landing field length is equal to the horizontal distance from a point 50 feet above the runway surface to the point at which the airplane comes to a full stop on the runway.

Those operators governed by FAR Part 91 determine landing distance from the Landing Distance chart. When the landing configuration speed is other than normal, the appropriate procedure in the Emergency section of the *AFM* provides a factor to apply to the normal landing distance.

When the runway is other than dry, the following factors should also be applied to the Landing Distance chart:

Wet—apply a 1.4 factor to the computed landing distance.

Wet (in the process of freezing)—apply a factor of at least 1.7 to the computed landing distance.

NOTE

For all operations, corrections to be applied to account for the presence of solid ice, snow, or slush are unknown.

Approach minimum maneuvering speeds are based on 1.3 times the airplane's stall speed with idle thrust in applicable configuration and a 30-degree bank angle. Minimum maneuvering speeds are as follows:

- No-flap configuration—V_{REF} + 40 KIAS
- FLAPS 8° configuration—V_{REF} + 30 KIAS
- FLAPS 20° configuration—V_{REF} + 20 KIAS
- FLAPS 40° configuration—V_{REF} + 10 KIAS

On final approach (with bank angle no more than 15°), 10 KIAS may be subtracted from the above speeds.

Landing Approach Speed (V_{REF})

V_{REF} is determined from the Landing Approach Speed (V_{REF}) chart in the *AFM*. Since V_{REF} is determined strictly by airplane gross weight, V_{REF} speeds listed in tabular form in the *Pilot's Manual* and *Checklist* may be used with equal accuracy.

Approach and Landing Speeds

See Definitions in this chapter for a description of approach climb speed and landing climb speed. Like landing approach speed, V_{REF}, approach, and landing climb are based strictly on airplane weight. Checklist data may not be current. Confirm accuracy of tabulated data with the approved *AFM*. Approach climb and landing climb speeds are provided on the same chart in the *AFM*.

WEIGHT AND BALANCE

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WEIGHT AND BALANCE COMPUTATION WB-1

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WB-2	Weight and Balance Schedule—Models 23 and 24 through 24F	WB-3
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WEIGHT AND BALANCE

GENERAL

The airplane weight and load arrangement must be within limits of the applicable center-of-gravity (CG) at all times. Prior to each flight, the pilot must make certain that the airplane is loaded within the defined limits to ensure acceptable stability, control, performance, and structural loads.

Weight and balance data are supplied in the Weight ad Balance Data section of the *AFM* by the manufacturer when the airplane is delivered.

Before any weight and balance computations can be made, the basic empty weight and resulting moment must be ascertained. This information is available from the Weight and Balance section of the *AFM* (Figure WB-1). Any changes to the airplane that affect weight and balance must be entered in the airplane records. It is advisable to check both pages to make certain that the weights and moments agree. The Weight and Balance Data section also contains all charts and tables necessary for CG computations.

WEIGHT AND BALANCE COMPUTATIONS

The first step in computing weight and balance is to determine the basic empty weight and moment from the Airplane Weighting Record in the *AFM*. However, if the airplane has been altered, determine the basic empty weight and moment from the Aircraft Records. The moment may be listed as a seven-digit figure, as shown in Figure WB-1. In this case, the decimal point must be moved three digits to the left when entering the moment on the worksheet. This is because all weight and balance charts and tables are based on moment per 1,000. This reduces the figures in the numerical data to a more manageable size.

When the weight and balance worksheet has been filled in, the center of gravity can be determined by using the graph, the chart, or by using the following formula:

$$\frac{\frac{\text{Moment}}{\text{Weight}} \times 1{,}000 - \text{LEMAC}}{84.49\ (\text{MAC})} \times 100 = \text{CG (\% of MAC)}$$

where LEMAC is 210.04 inches for all 23 and 24 models and 360.02 inches for all 25 models

Weight and balance computation worksheets for three model groupings are shown in Figures WB-2 through WB-4.

Figure WB-5 shows two examples of airplane equipment needed for weight and balance computations. On the left is a typical portrayal of the 23 and 24 series Learjets. On the right is the 25 series.

BASIC EMPTY WEIGHT 7,254 lbs
(Includes Unusable Fuel)

C.G. 236.283 in.

MOMENT 1,714,000

It is the responsibility of the airplane owner and pilot to insure that the airplane is loaded properly. The basic empty weight and center of gravity noted are for the airplane as delivered from the factory. In the event the airplane has been altered, refer to the Aircraft Records.

Owners are advised to contact the airplane manufacturer when any change is made to the airplane which would appreciably affect the location of the empty center of gravity or location of useful load items.

WEIGHT AND CENTER OF GRAVITY LIMITS

The Forward CG Limit is 16% MAC for all weights up to and including 9,000 pounds and tapers to 22.6% MAC at 13,800.

The Aft CG Limit is 31.5% MAC for all weights.

Maximum Takeoff Weight is 13,500 pounds.
Maximum Landing Weight is 11,880 pounds.
Maximum Ramp Weight is 13,800 pounds.

The Normal Empty Weight Center of Gravity is Aft of the Flight Limit

AIRCRAFT WEIGHT RECORD

Date		Model 240		Serial No.	
Place				Weighing Personnel:	
Reaction	Scale Reading	Tare	Net Weight	Arm	Moment
Total (as weighed)					
Total Items Column I			-		
Total Items Column II			+		
Basic Airplane	(Includes Unusable Fuel)				

COLUMN I

Items weighed but not part of basic airplane	Weight	Arm	Moment
Total			

COLUMN II

Basic items not in when weighed	Weight	Arm	Moment
Total	7,254		1,714,000

Figure WB-1. Basic Empty Weight Moment Sources (Weight and Balance Data)

LEARJET MODEL 23, 24, 24B, 24D, 24E, 24F
WEIGHT AND BALANCE SCHEDULE

	STATION	QUANTITY	WEIGHT	MOMENT	C.G.
Basic Empty Wt.	xxxx xxxx	xxxx xxxx			
Crew	103	2			
Provisions	114	xxxx xxxx			
Provision-Powder Rm.	144	xxxx xxxx			
Wash Basin	135	xxxx xxxx			
Chemical Toilet	127	xxxx xxxx			
Operating Weight	xxxx xxxx	xxxx xxxx			
Passenger-Jump Seat	124	1			
Passenger-Potty	132	1			
Passengers-Swivel	167	2			
Passengers-Divan	210	3			
Baggage (Max. 500 lbs)	252				
A/C Less Fuel	xxxx xxxx				
Fus. Tank (Fuel)	xxxx xxxx				
Wing Bending Weight					
Wing Tank (Fuel)	xxxx xxxx				
Tip Tank (Fuel)	xxxx xxxx				
Ramp Weight	xxxx xxxx	xxxx xxxx			
Taxi Burnoff Out of Tip. 10# per eng. per min.					
Take Off Weight					
A/C Less Fuel	xxxx xxxx	xxxx xxxx			
Wing Tank (Fuel	xxxx xxxx				
Tip Tanks (Fuel)	xxxx xxxx				
Fus. Tank (Fuel)	xxxx xxxx				
Landing Weight	xxxx xxxx				

Figure WB-2. Weight and Balance Schedule—Models 23 and 24 through 24F

LEARJET MODEL 25, 25B, 25D
WEIGHT AND BALANCE SCHEDULE

	STATION	QUANTITY	WEIGHT	MOMENT	C.G.
Basic Empty Wt.	xxxx xxxx	xxxx xxxx			
Crew	217	2			
Provisions	228	xxxx xxxx			
Provision-Powder Rm.	258	xxxx xxxx			
Wash Basin	249	xxxx xxxx			
Chemical Toilet	241	xxxx xxxx			
Operating Weight	xxxx xxxx	xxxx xxxx			
Passenger-Jump Seat	238	1			
Passenger-Potty	246	1			
Passengers- - Fwd. Swivels	294	2			
Passengers- - Aft. Swivels	327	2			
Passengers-Divan	360	3			
Baggage (Max. 500 lbs)	402				
A/C Less Fuel					
Fus. Tank (Fuel)	Max. 1307 lbs	xxxx xxxx			
Wing Bending Weight					
Wing Tank (Fuel)	Max. 2325 lbs				
Tip Tank (Fuel)					
Ramp Weight	xxxx xxxx	xxxx xxxx			
Taxi Burnoff Out of Tip. 10# per eng. per min.					
Take Off Weight					
A/C Less Fuel	xxxx xxxx	xxxx xxxx			
Wing Tank (Fuel	xxxx xxxx				
Tip Tanks (Fuel)	xxxx xxxx				
Fus. Tank (Fuel)	xxxx xxxx				
Landing Weight	xxxx xxxx				

Figure WB-3. Weight and Balance Schedule—Models 25, 25B, and 25D

LEARJET MODEL 25C/F
WEIGHT AND BALANCE SCHEDULE

	STATION	QUANTITY	WEIGHT	MOMENT	C.G.
Basic Empty Wt.	xxxx xxxx	xxxx xxxx			
Crew	217	2			
Provisions	230	xxxx xxxx			
Operating Weight	xxxx xxxx	xxxx xxxx			
Passenger-Potty	250	1			
Passengers - Fixed	284	2			
Passengers - Fwd. Swivels	294	2			
Passengers - Aft. Swivels	327	2			
Passenger-Divan	337	2			
Baggage (Max. 500 lbs)	360				
A/C Less Fuel					
Fus. Tank (Fuel)	Max. 2600 lbs	xxxx xxxx			
Wing Bending Weight					
Wing Tank (Fuel)	Max. 2325 lbs				
Tip Tank (Fuel)	Max. 2466 lbs				
Ramp Weight	xxxx xxxx	xxxx xxxx			
Taxi Burnoff Out of Tip. 10# per eng. per min.					
Take Off Weight					
A/C Less Fuel	xxxx xxxx	xxxx xxxx			
Wing Tank (Fuel	xxxx xxxx				
Tip Tanks (Fuel)	xxxx xxxx				
Fus. Tank (Fuel)	xxxx xxxx				
Landing Weight	xxxx xxxx				

Figure WB-4. Weight and Balance Schedule—Models 25C/F

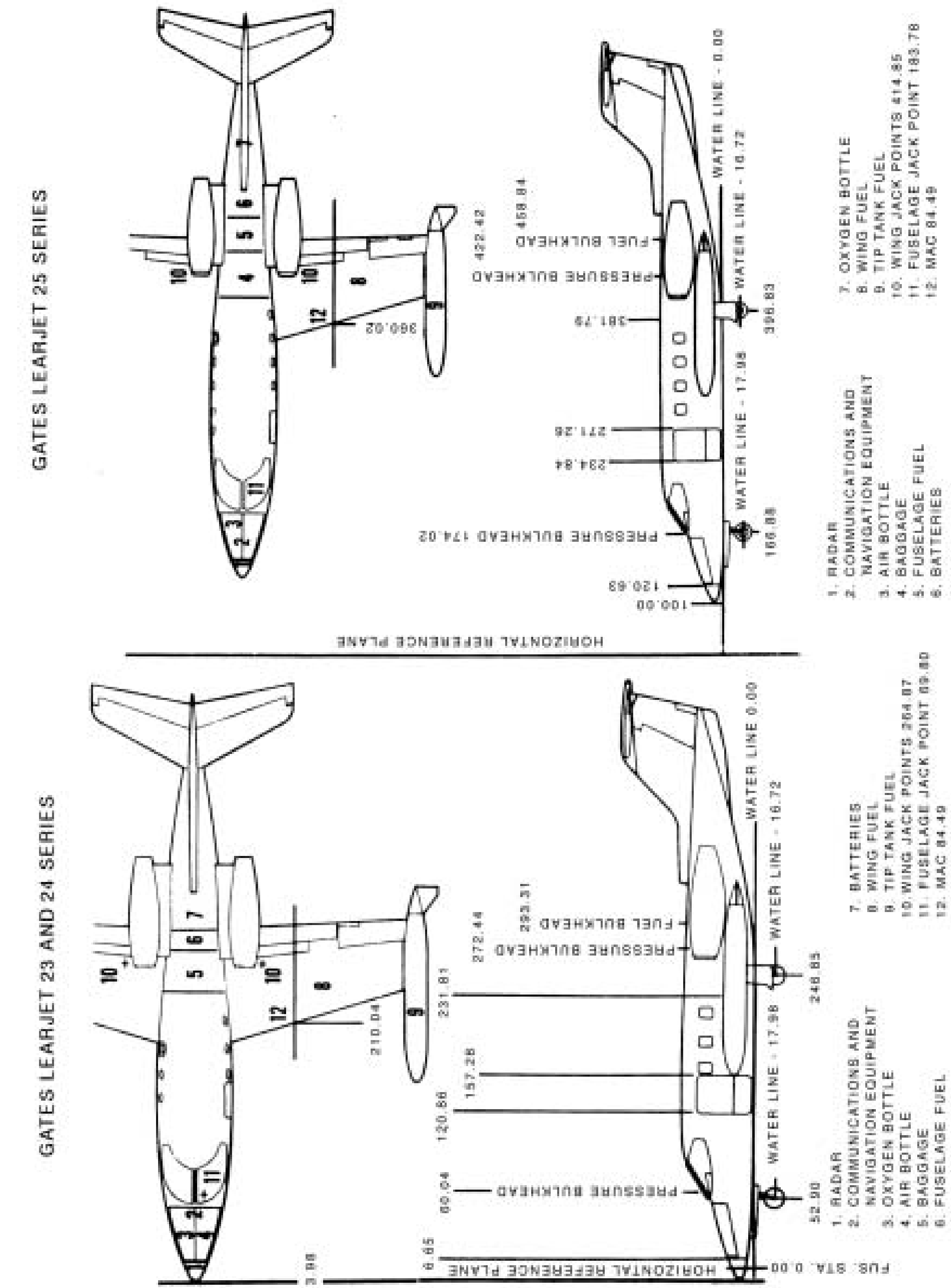

Figure WB-5. Airplane Equipment Configuration

CREW RESOURCE MANAGEMENT

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CREW RESOURCE MANAGEMENT (CRM) CRM-1

ILLUSTRATIONS

Figure	Title	Page
CRM-1	Situational Awareness in the Cockpit	CRM-1
CRM-2	Command and Leadership	CRM-1
CRM-3	Communication Process	CRM-2
CRM-4	Decision Making Process	CRM-2

CREW RESOURCE MANAGEMENT (CRM)

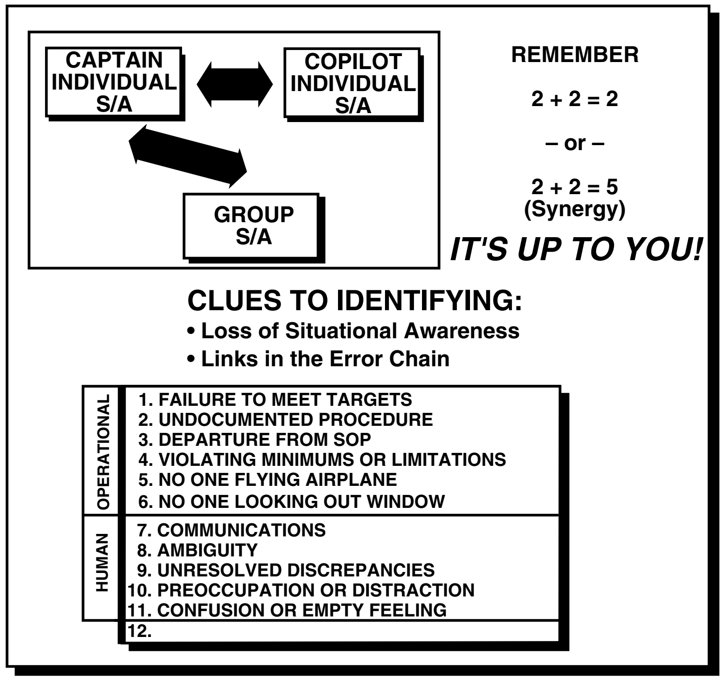

Figure CRM-1. Situational Awareness in the Cockpit

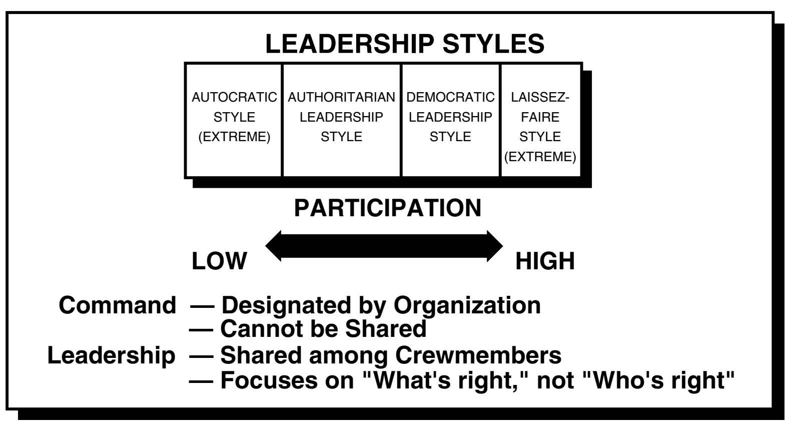

Figure CRM-2. Command and Leadership

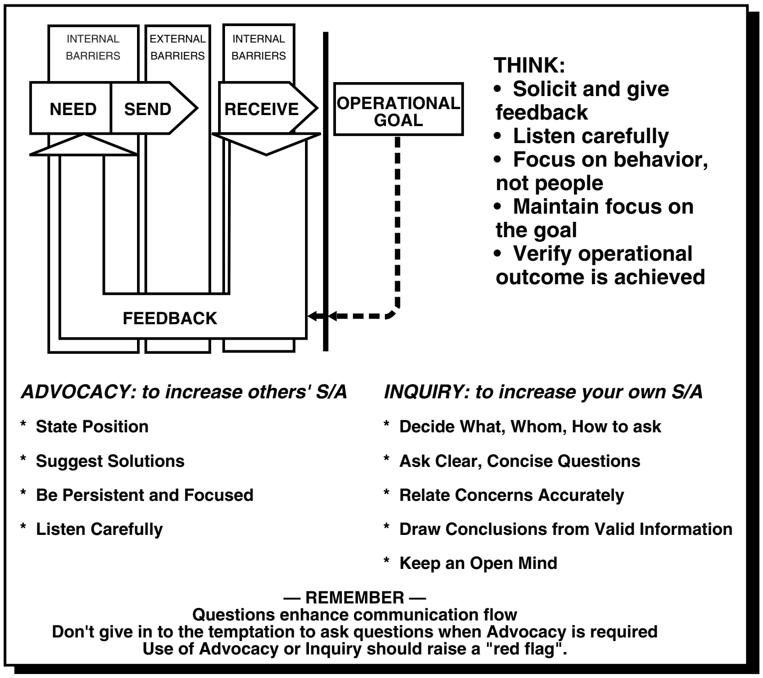

Figure CRM-3. Communication Process

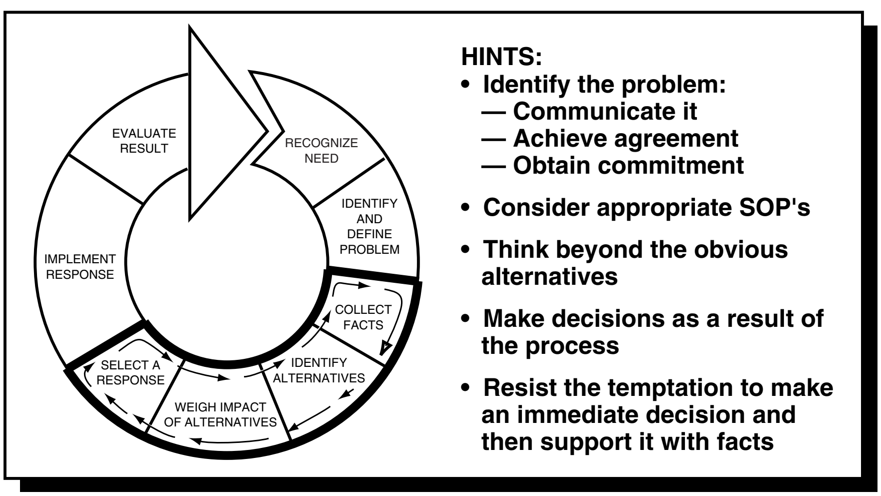

Figure CRM-4. Decision Making Process